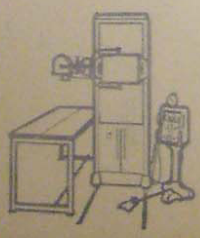



MODERN SHOCKPROOF X-RAY AND ELECTROMEDICAL EQUIPMENT

Distinguished for Outstanding Performance and Great Durability

ULTRASONICS

H. G. FISCHER & CO.




H. G. FISCHER & CO.

Manufacturers
X-ray and Electromedical Equipment

9451-91 W. BELMONT AVENUE
FRANKLIN PARK, ILLINOIS
(SUBURB OF CHICAGO)

ULTRASONICS

Introduction

At rare intervals a therapy portending spectacular effectiveness is presented to the healing professions. In almost every instance the introduction of such energies, and the devices by means of which they are generated, follows a familiar pattern. Initially comes the stage of fantastic claims engendered by the pioneer enthusiasts. Then appears the "alarm campaign" fostered by research skeptics through experiments on animals and the assumption of potential dangers attending clinical application on humans. Finally emerges the era of universal acceptance imposed by the irrefutable evidence secured in thousands of routine cases by progressive leaders in their fields.

The pattern is illustrated nicely by the histories of some of the thermal energies and devices in general use today. After World War I, Diathermy, as generated by Spark Gap apparatus, became a universally used modality. When Short Wave apparatus, an import from Germany, appeared in 1933-4, it was accompanied by the usual fantastic claims based on the works of Schliephake. Promptly, the "alarm campaign" came into being through the interjection of doubt as to the possibility of unknowingly overheating internal organs. Yet, presently, Short Wave Diathermy is considered a dependable and safe procedure among all professions.

A more recent example of this pattern is found in the introduction of the so-called "radar" - microwave - Diathermy apparatus presented just a few years ago. First, the exaggerated claims for this "new" energy; then, the "fear campaign" in the creation of doubt as to the danger of producing lenticular opacities and deep tissue damage; but, finally, the device is found in daily use in hundreds of professional offices.

Today, the therapeutic use of sound waves at frequencies far beyond the range of human hearing - variously termed "Ultra Sonics", "Sonar", "Ultra Sound", "Hyper Sonics", etc. - is undergoing a parallel experience and is just now emerging from the stage of alarm reaction.

A review of the existing literature on the subject reveals that such energies have been under investigation, both in the United States and Central Europe, as far back as 1927. Following a period of inactivity during the years of World War II, research was resumed and the findings were of sufficient interest to warrant the convening of interested workers in the Erlanger (Germany) Ultrasound Congress in May, 1949. Progress in the following year resulted in the International Ultrasound Congress in Rome in 1950.

Currently, at the meeting of the American Congress of Physical Medicine and Rehabilitation in Chicago, September, 1953, an entire morning was devoted to a "Symposium on Ultra Sound", a program of four papers by the following well known American authorities and investigators:

1. "Investigation of Possible Cavitation Occuring in Biologic Systems following Exposure to Ultra Sound" by J. F. Lehmann, M.D., Mayo Clinic, Rochester, Minn.

2. "Review of Literature and Clinical Applications of Ultrasonics" by A. A. Martucci, M.D., University of Pennsylvania, Philadelphia, Pa.

3. "Indications and Contra-Indications for Ultrasonic Therapy" by J. H. Aldes, M.D., Cedars of Lebanon Hospital, Los Angeles, Calif.

4. "Ultra Sound and Treatment of Sears" by Wm. Bierman, M.D., Columbia University, New York City.

Out of the wealth of experience reported by these qualified observers came the conclusion that in the thousands of treatments given, "not one severe local or systemic reaction occurred."

The present status of Ultrasonic therapy is best summed up in the words of Kenneth Phillips, M.D., F.A.C.S. Jackson Memorial Hospital, Miami, Florida, in a paper read before the Florida Medical Association at Hollywood Beach, April 26, 1953:

"It (Ultrasonic energy) has been sufficiently tested to assure its safety providing its use is by those properly trained in basic fundamentals."

"Results of this study, together with voluminous reports from European and American scientists, justify an opinion that this energy offers wide future possibilities."

"The most outstanding therapeutic results of this study have been with traumatic injuries, acute bursitis and low back distress."

Ultrasonics Versus Diathermy Energies

In the consideration of the Ultrasonic energies as a therapeutic agent the fallacy that they are a form of Diathermy should be dismissed immediately. Any heating of tissue which may occur during Ultrasonic application is a by-product and not the prime objective. In fact, such heating is considered objectionable by some observers as an indication of improper technic. Dr. D. Wulff, M.D., states: "The limits (dosage) are set by the accumulation of heat which evolves in the case of higher dosages, either by the thermal overloading of the skin surface or at the inner interfaces, which frequently produce a most disturbing effect, that is, periosteal pain."

The differentiation between Ultrasonic energies and the radio frequency energies employed in Diathermy is very distinct.

When one head of a bass drum is struck, the opposite head also vibrates in synchronism because the motion imparted to the struck head is transmitted through the air within the drum by "sound" waves, i. e., actual motion of the air in the form of alternate compression and decompression which causes the opposite head to move to and fro in like manner.

The factor of importance is that a primary mechanical motion is required to inaugurate the air movement producing the related motion of the opposite member. The same phenomenon is observed in the every day use of the telephone receiver. Electromagnetic impulses cause a diaphragm in the receiver to move to and fro. When the receiver is held near the ear, the air movement is transmitted to the ear membrane which vibrates in like manner and the auditory nerve interprets this motion as speech or sound.

The radio frequencies employed in Diathermy are a radiant energy which do not produce air motion. The action is an electrical phenomenon rather than a mechanical function.

The single factor in common between Diathermy electrical energies and Ultrasonic mechanical energies is that both oscillate at high rates of frequency. The older type of Spark Gap Diathermy Unit oscillated at a frequency in the order of 1,000,000 cycles per second. Modern Short Wave apparatus operates at frequencies in the order of 26,000,000 per second. Ultrasonic apparatus functions at frequencies from some 300,000 to 3,000,000 cycles per second. In this respect, V. Buchtala, M.D., Lecturer in Radiology, Wurzburg (Germany) University Clinic for Surgery, writes in the British Journal of Physical Medicine, January, 1952: "Extended investigations have also shown that the frequency of the waves (ultrasonic) has little effect upon the clinical result provided that it lies somewhere between 300,000 and 1,500,000."

Since the human ear mechanism can not interpret "sound" waves much beyond a frequency of 12,000 cycles per second the terminology which has been applied to this newer energy becomes obvious: "ultra", beyond (the range of human hearing);"sonics", the science of "sound".

As a definite distinction of the difference in the physical properties of Diathermic radio frequency energies and Ultrasonic energies, it is well established that radio frequency energies may be transmitted through a vacuum, whereas "sound" waves require matter for their propogation and air, or matter, for their conduction.

Audible sounds may be transmitted relatively great distances through air depending upon the intensity, or volume, of the "sound" wave. However, as the sound frequency increases the air transmission decreases to the point that at therapeutic Ultrasonic frequencies transmission is lost in even the minutest air layer. This property necessitates the use of some medium of matter - usually oil or soap solution - in bodily contact to conduct the energy into an anatomic region.

Conversely, the radio frequencies of Diathermy are easily transmitted through air as is well illustrated in therapy by the common "air-spaced" technic of application.

These essential differences between Diathermy and Ultrasonic energies are stressed because it is imperative that the user of Ultrasonic devices shall understand the distinct individuality of this form of therapy in order to obtain the utmost in splendid results which lie within its capabilities.

Ultrasonic Generators

It has been shown that a primary mechanical motion is necessary to propogate "sound" waves. The high frequencies recommended for therapeutic Ultrasonics necessitate - at least to date - the use of the "piezo-electric effect", discovered in 1880 by P. Curie, peculiar to crystalline substances. The most commonly used substance is quartz due to its strength and activity.

When a quartz plate is cut from a mother crystal along predetermined lines of activity and precisely ground to a specific dimension, it possesses the singular property of being able to oscillate only at the frequency for which it was ground. Then, when an alternating electric current of exactly matching frequency is impressed upon the plate it becomes mechanically active by alternate compression and decompression within its own structure. While the limits of motion are small, the movement is vigorous and can be made to occur - within reasonable limits - at any desirable speed merely by altering the physical dimensions of the quartz plate. Utilization of the "piezo-electric effect" is seen in any "crystal controlled" electronic device.

Hence, to produce mechanical motion at frequencies sufficiently rapid for therapeutic Ultrasonics, it is necessary only to provide a quartz plate of the proper characteristics, a holder for the plate and a high frequency oscillator tuned to match the plate frequency. In this word description the process seems simple; in practice it becomes a procedure demanding exact precision and careful craftsmanship.

The quartz plate holder - variously termed "sounding head", "transducer", etc. - presents the initial problem. First, it is obvious that the portion of the "sounding head" which contacts the anatomic area under treatment must possess exactly the same properties of oscillation as the quartz plate to prevent it from absorbing the mechanical motion and damping the total output. This demands material of the proper composition and precise-

fabrication as critical as that required in the preparation of the quartz plate. In addition, the handle portion of the sounding head must be thoroughly damped to obviate undue exposure to the operator.

The optimum frequency, output and current characteristics of the apparatus may be adjudged from the statements of Buchtala published in the British Journal of Physical Medicine, January, 1952: "Using such data and comparing results, it is found that a minimum output of 3 watts per square centimeter (of sound-head contact area) has to be demanded, although a fixed sound-head requires only a fraction of this intensity. In theory it might be possible therefore to work with lower intensities than 3 watts per square centimeter, but the fixed sound-head is not always applicable and modern instruments have a total output of 25-40 watts (total over entire contact area), thus providing for an adequate area of emission. Higher intensities have not proved of any value in clinical practice. Extended investigations have also shown that the frequency of the waves has little effect upon the clinical result provided that it lies somewhere between 300,000 and 1,500,000 cycles per second . . . . The choice between modulated (with rectifier tubes in the oscillator) and unmodulated (without rectifier tubes) has been decided in favor of the former".

Biologic Effects of Ultrasonics

Excerpts from the previously mentioned paper of Dr. Kenneth Phillips, M.D., concisely summarize the biologic effects of Ultrasonic energies: "Extensive research by Europeans; work in process by Rosenthal (Harry Rosenthal), New York City, "Ultrasonics in Clinical Medicine", June 1950) on proteins, minerals, fats, sugars, etc., all reveal evidence of biologic effects other than thermal. Intracellular metabolic effects, analgesia, microcellular vibration, action on nervous, blood and lymph systems have all been included in the biologic survey".

Nelson, Herrick and Krusen in the Archives of Physical Medicine, January, 1950, list the effects of Ultrasonic energy as "mechanical, thermal, chemical, biologic and physiologic".

Thus, several interesting approaches to the biologic effects are presented. It would seem logical to assume that the "microcellular vibration induced by Ultrasonic application should influence membrane permeability and, hence, osmotic interchange of intracellular fluids. This phenomenon, probably, is the basis for Phillip's conclusion of "interacellular metabolic effects".

The analgesic effect of Ultrasonic radiation is brought out in several ways. K. Stuhlfauth, M.D., Medical Clinic of Munich, Germany, in the British Journal of Physical Medicine, January 1952, states: "Ultrasonic therapy often is remarkably successful in introducing analgesia in the persistent and unrelenting pain following upon herpes zoster. We have seen three such cases in which two or three sonations produced freedom from pain previously not achieved by procaine infiltration or even X-Rays".

Additionally, and more recently, Irving Tepperberg, M.D., and Elemer J. Marjey, M.D., respectively chiefs of Physical Medicine Rehabilitation and Physical Medicine Group, Veterans Administration, New York Regional Office,

report in the American Journal of Physical Medicine, February, 1953, on the analgesic effects of Ultrasonics in painful post-operative neurofibromas: "Dramatic relief of symptoms was obtained in four of the five patients . . . Ultrasonic radiation appears to have an almost specific action on painful neuromas. There were no harmful effects produced by Ultrasonic radiation in any of our patients".

From this it would appear that the analgesia might be closely associated with both the thermal and mechanical effects of Ultrasonics as cited by Krusen et al. In support of this conclusion Stuhlfauth, in the paper previously reported, says: "The conductivity of isolated nerve muscle preparations is demonstrably altered by Ultrasonic waves. Schmitz showed that the decline in conductivity of a nerve, caused by raising its temperature, is accelerated by increased frequency of impulses." Whether the analgesia is a result of indirect heating of the nerve or the inhibitory action of the rapid mechanical vibration is open to discussion. However, the factor of importance is its proved ability to cope with pain in many conditions.

Effects on nervous, blood and lymph systems are equally well founded and reported by many observers. The summation of A. W. Bauer, M.D., London, is striking: "What is more important, the effect of Ultrasonic therapy is not limited to the region to which it is directly applied. It would rather appear that Ultrasonic impulses invoke neural effects of various types and intensities (remote action). The effects range from simple vasomotor reflexes, resulting in hyperemia or vasoconstriction respectively according to the dosage employed, to changes in the functional state of the autonomic nervous system as a whole . . . It would appear from the work of Tschannen that Ultrasonic waves are particularly effective when applied not only to the affected joint or area but to the governing spinal nerve-roots".

In addition to "good beaming" and "high depth penetration" and the proved effectiveness reported by the many experienced workers in both European and American centers, Phillips summarizes Ultrasonic therapy in a most impressive statement: "I have been unable to find any record, written or oral, where within the intensities prescribed for therapeutic use, anyone has been able to produce tissue destruction without first exceeding the physiological pain threshold. What other physical modality gives the therapist such a safety valve?"

Indications for Ultrasonic Therapy

As in the case with many other forms of therapy, Ultra Sound energies have shown surprising results in some conditions, only fair in others and none at all in some cases. However, the weight of evidence in those conditions for which it is recommended is favorable and conclusive. Perhaps the best approach to the indication for Ultrasonic applications is in a summation of the findings of experienced observers as reported in current literature:

Bursitis, Acute . . . Phillips reports on 10 cases treated, which had previously received heat or injections, and all 10 obtained good results. Tschannen reports satisfactory results in chronic cases and states, further, that disappearance of shadows due to calcification is observable radiographically with clinical effects shown by improved range of motion and freedom from pain. In a survey of the results obtained by European workers, each of whom had treated more than one hundred different cases, Stuhlfauth and Woeber report excellent results in 41.5%; good results in 48%; no improvement in 10.5%.

Rheumatic Disorders of Muscles and Periarticular Tissues . . . Tschannen makes the following interesting observations: "In addition to the principal field of indication - that of the degenerative joint disorders - excellent results are seen in muscular rheumatism, lumbago, torticollis and muscular spasticity of the shoulder-girdle, which is still often called plexus neuralgia. After 4 to 6 soundings freedom from symptoms is usually found". In the Stuhlfauth-Woeber survey the results in Lumbago showed 74% excellent, 25% good and 1% no improvement; for Myalgia the results were 72% excellent, 26% good and 2% no improvement.

Rheumatic Diseases of Degenerative Type . . . Theo De Preux, writing in the British Journal of Physical Medicine, January, 1952, in an extensive monograph titled "Ultrasonic Therapy in Osteoarthritis of the Hip Joint", includes not only the hip joint, but the knee, and the spine as well. The conclusions are well stated in the following excerpts: "In pure arthrosis pain, stiffness and limited mobility react favorably. Of course, Ultrasonic therapy will not improve movements limited by deformities of the bone . . . Osteoarthritis of the spine is also improved by Ultrasonic waves. We consider cervical spondylitis, usually so difficult to influence, especially in its severe form, apt to be greatly improved by extensive Ultrasonic therapy. This improvement applies to pain as well as to active and passive movements in the great majority of cases".

De Preux's observations concerning the hip joint are conservation and best stated in his own words: "Ultrasonic therapy does not solve the problem of osteoarthritis of the hip joint. Its value will be limited in advanced cases with destruction, severe mechanical and static impairments. But for the great majority of cases of osteoarthritis at their onset, and many of the moderate ones, Ultrasonic therapy well applied improves subjective symptoms; relief from nocturnal pain, then from pain in walking".

Acute Trauma . . . In 72 cases involving acute trauma of joints, back and fractured ribs, Phillips summarizes results as good in 52, moderate in 12 and none in 8. Tschannen presents the postulation that Ultrasonics is of value in the after-treatment of fractures, especially in joints. He says; "The fixation of joints which occurs after intra-articular fractures and is caused by muscular hypertony is favorably influenced by Ultrasonic therapy. Because of its simultaneous action on the vascular system, the much dreaded complication of arthrosis may be avoided".

A number of team trainers in the United States have discovered the value of Ultrasonics in treating the contusions and bruises common to athletic competition such as "charley horse", sprains, strains, etc.

Sciatica - Neuritis . . . Buchtala states: "In about 75% of cases freedom from pain is reported after a series of fifteen to twenty applications. Sciatic conditions which do not react to Ultrasonics are usually of the symptomatic type caused by compression of the roots and secondaries . . . Similarly, neuritis of the plexus brachialis reacts as well as sciatic neuralgia".

Tschannen's position is somewhat individual. He says: "True neuritis of the sciatic nerve is a rarity. It is questionable whether the interpretation of Lasegue's sign as eliciting pain by the stretching of the inflamed nerve is appropriate. It seems much more to consist in pain due to stretching of the hypertonically stiffened and reflexly ischaemic muscles. This ischaemia would also explain the parathesia. In such cases, also, radicular Ultrasonic applications produce successful results." In the Stuhlfauth-Woeber survey the results from treatment of sciatica with Ultrasonic therapy are segregated as follows: very good, 55.5%; good, 42%; no improvement, 2.5%.

In summary it can be stated conservatively that Ultrasonic therapy is now sufficiently well established to warrant its inclusion in the physical medicine approach to a number of conditions. Phillips concludes: "The most outstanding therapeutic results of this study have been with traumatic injuries, acute bursitis and low back distress". Tschannen offers a word of sound advice: "Once more, stress must be laid on the importance of making an exact diagnosis. The correct diagnosis, combined with appropriate application and dosage, is decisive in producing an optimal result". Bauer, of London, editorializes: "Most critical authors agree now that Ultrasonic therapy has specific merits primarily in the field of rheumatology. This limitation of ultrasonics is balanced by the recognition that within this limited field it can claim outstanding success".

Most workers concur in the opinion that the known effectiveness of Ultra Sound waves in specific conditions is but a forerunner of far more extensive application as more clinical evidence is accumulated. Phillips summarizes this postulation well in his statement: "Results of this study, together with voluminous reports from European and American scientists, justify an opinion that this energy offers wide future possibilities".

Contra-Indications

The contra-indications for therapeutic use of Ultrasonics are few but specific. It is best perhaps to enumerate them as follows:

The "MUST NOTS"

1. Malignant Tumors of any type
2. The ganglion stellatum in heart disorders or heart instability.
3. The pregnant uterus.
4. The orbit of the eye.

Treatment Methods

There are several methods for administering the Ultrasonic energies. One is termed the "contact" method to describe the application in which the "sound head" is maintained in actual contact with the tissue. It has been pointed out previously that some medium of matter, mineral oil or soap solution, must be used to obviate the cushioning effect of any air layer. So, a generous layer of this substance is spread over the area to be treated and the sound head is in firm contact, in fact with slight pressure, to the area under treatment.

Two variations of the "contact" method have been employed, the "stationary" and the "massage" treatment. In the "stationary" application the "sound head" is held at a fixed point throughout the treatment. In the "massage" application the "sound head" is moved slowly and rythmically around over the entire area of the local involvement.

The exponents of the "stationary" method base their concept on the premise that sounding of certain critical points (Head's zones, spinal roots and ganglia) affects an extensive area or region, such as a joint. However, in the "stationary" method the intensities of dosage, i.e., watts per square centimeter, must be maintained at a much lower level than with the "massage" method.

Exponents of the "massage" method point out that this type of application produces a uniform distribution of energy over the entire treated area and does not require the exactness of beaming necessary in the stationary type of treatment.

Tschannen postulates on the effectiveness of a combined stationary and massage application which he terms "radicular" treatment. In his own words he says: "Of the time expended (treatment duration) two-thirds should be employed for the nerve roots and one-third for the affected joint. The dosage varies, according to the fatness or thinness of the patient, between 8 and 15 watt output for a movable sound-head (massage) or 0.8 to 2 watts for a stationary application". In this connection Tschannen publishes the following table of the nerve roots to be treated for the joints affected:

Affected Joint	Nerve Root
Hip	3rd to 5th Lumbar Vertabrae
Knee	12th Thoracic to 3rd Lumbar
Ankle	1st to 4th Sacral
Shoulder	4th Cervical to 2nd Thoracic
Elbow	4th Cervical to 6th Cervical
Wrist and Hand	5th Cervical to 2nd Thoracic

When the anatomic surface is uneven, as is the case with the ankle or small joints, the sounding may be made conveniently under water. In this case the part to be treated is immersed in a vessel of warm water and the sound-head also is immersed and directed within 1/2" to 1" from the affected joint. The water between the part and the sound-head constitutes the media through which the Ultrasonic waves are conveyed into the tissue.

Dosage

The matter of dosage in the application of Ultrasonic waves probably has been one of the most discussed subjects in this form of treatment. However, in the light of present day knowledge, accumulated in the clinical treatment of many hundreds of cases, the estimation of dosage is not as difficult as it might appear.

First, it must be conceded that due to the character of the involvement, the acute or the chronic; the locale of the affected region, deep-seated or superficial; and the variation in response of the individual, no rigid rule of dosage can be stated. But, this situation is no more unusual than that attending the administration of diathermic therapies in which the tolerance of the patient is the accepted dosage guide.

Two or three principles are well established in the application of Ultrasonic waves. One is that the use of a high intensity for a short time is not as effective as the application of lower intensity for a longer time. Here, again, is a parallel to diathermic treatment. Second, it is well established that chronic conditions require a more vigorous action than acute conditions. Also, since Ultrasound energies decrease in intensity with depth of tissue, deeper seated lesions require a correspondingly greater intensity than superficial involvements. And, finally, the "stationary" method of application demands much less energy than the "massage" type of application.

Buchtala cites probably the most dependable dosage guide in his statement that "the patient by reporting subjective pain determines the permissible limit of dosage. From which it would appear that in Ultrasonic applications, also, the patient's tolerance is the most reliable guide.

A number of experienced users of Ultrasonic energies have rationalized the dosage problem by beginning all treatments with relatively low intensities and gradually increasing in each subsequent treatment until the threshold of pain has been established. This is somewhat similar to the method employed in Ultra Violet irradiations to determine the individual reaction of the patient.

The duration of treatment is flexible. A number of writers suggest 6 minutes per treated area as the optimum. The time is somewhat dependent upon the method employed, i.e., the stationary or massage and whether contact or under water. No ill effects have been reported from treatments enduring as long as 10 minutes as long as the intensity is maintained below the pain threshold.

The frequency of treatment has been reported by various workers as ranging from daily applications in acute and sub-acute involvements to once or twice weekly in chronic conditions. While some acute conditions respond spectacularly to a few applications, the merits of Ultrasonic applications in a specific involvement should not be adjudged until a reasonable number of treatments, even 15 or 20, have been given. It is not unusual for the patient to report a delayed beneficial response several days after cessation of the applications.

In general, Ultrasonic therapy, its application and its dosage should be considered in the same light as other physical agencies. Failure in one or two cases should not constitute total condemnation because too many brilliant successes are a matter of record.

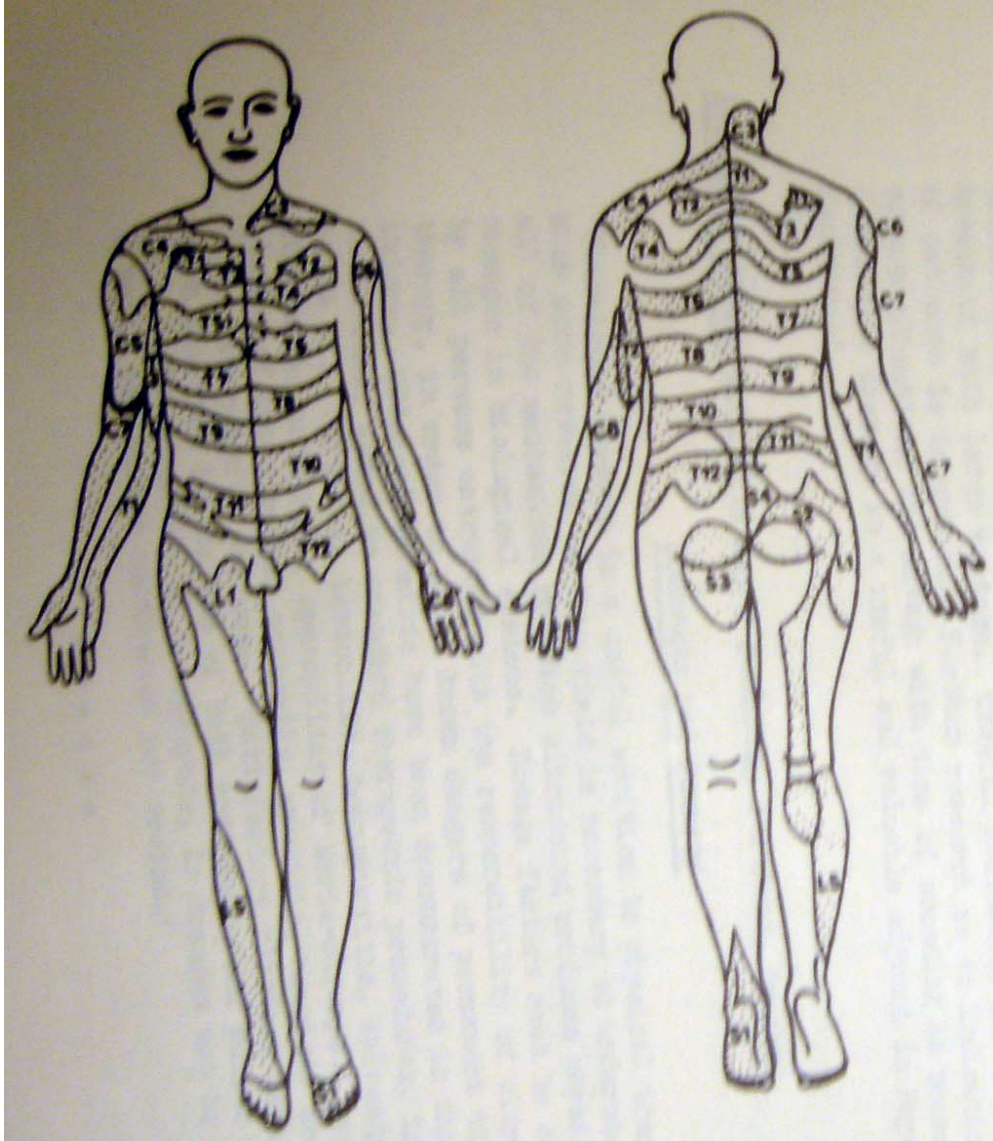
* * * * * * * * * *

A FEW TREATMENT SUGGESTIONS

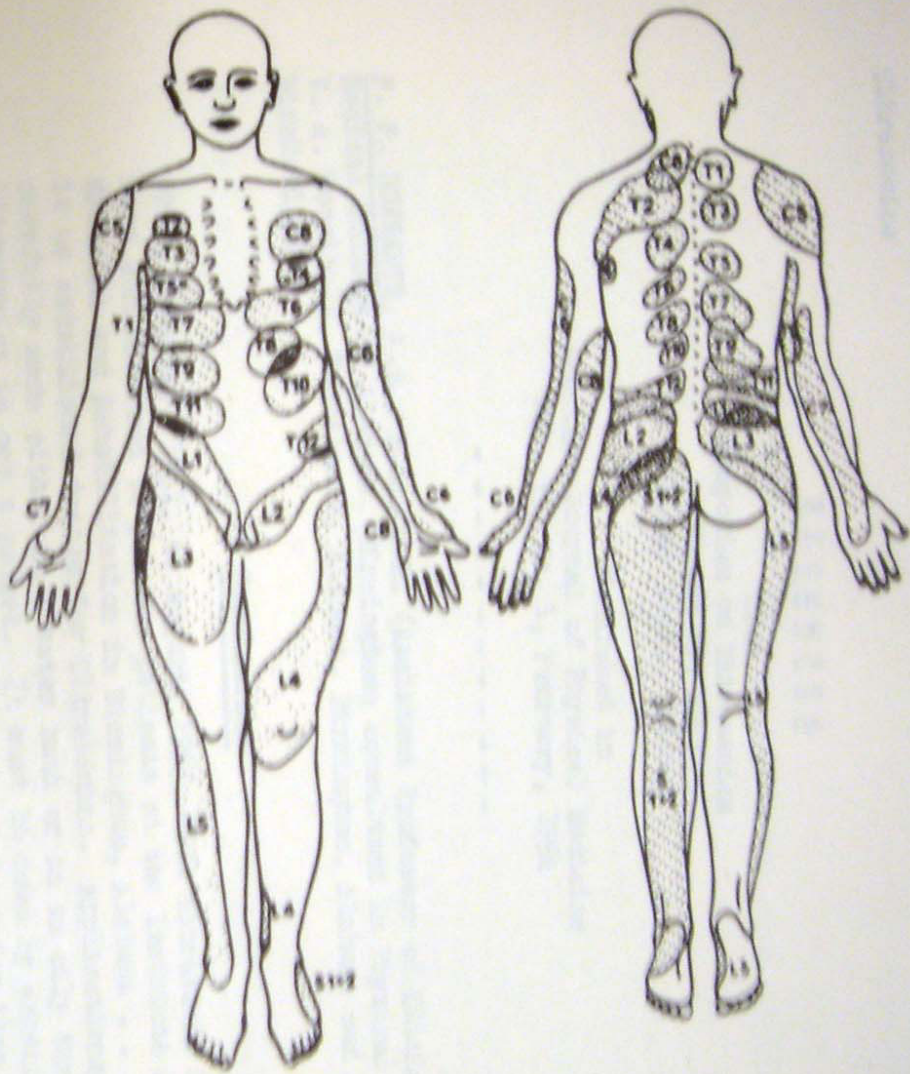
CONDITION	AREA TREATED	DOSAGE W/CM²	DURATION (MINUTES)	RADICULAR TREATMENT PARAVERTEBRAL NERVE SEGMENTS TREATED	DOSAGE W/CM²	DURATION (MINUTES)	COMMENT
BURSITIS	Upper head of humerus and coracoid process, slowly rotating transducer over area 3"x3" point of shoulder and forward over upper bicep.	.5 to 1	4 - 6	C-4 to Th-2 as well as nerve distribution to shoulder.	.3 to .5	4 - 5	Daily in acute stages, then twice weekly. Treat shoulder first and then nerve roots at each setting. It is important that speed of rotation be slow, taking approx. 2 seconds each.
SPONDYLITIS	Paravertebral over affected area.	.3 to .6	6 - 8				Treat 2 adjacent paths on each side with slow straight upward stroke and slow rotating motion downward along the length of the spine affected.
ARTHRITIS (At the onset and Hypertrophic types)	Over affected area in direct contact if area permits or underwater for small joints of feet and hands.	.5 to 1	4 - 6 8 - 10 Under Water	Wrist and fingers: C-5 to Th-2 Elbows: C-4 to C-6 Shoulders: C-4 to Th-2 Ankle: S-1 to S-4 Knee: Th-12 to L-3 Hip: L-3 to L-5	.3 to .5 .3 to .5 .3 to .5 .3 to .5 .3 to .5 .3 to .5	4 - 5	Degenerative joint disorders may require 12-15 sessions and may be resumed after a rest period of 1 to 2 months. Objective is relief of pain & significant restoration of function.
NEURITIS	Over nerve distribution affected.	.3 to .6	4 - 6	Corresponding nerve roots.	.3 to .5	4 - 5	Nerve pathways should be accurately located and used as target of ultrasound application.
SCIATICA	Sciatic nerve at level of gluteal fold and distribution along thigh.	.3 to .6	4 - 6	Root of sciatic nerve (Sacral Plexus)	.3 to .5	4 - 5	Radicular treatment important especially when caused by anatomical changes in the spine including intervertebral discs.
OSTEOARTHRITIS (HIP JOINT)	3 areas aim at the trochanteric and supertrochanteric region. The groin, anterior & posterior aspects.	.5 to 1 (or below level which provokes pain) Rotating motion.	4 min. per area	L-3 to L-5	.3 to .5	4 - 5	Depending on condition of hip joint, at the onset, moderate or severe osteoarthritis, 6-12 sessions may be needed. Objective is to reduce nocturnal pain, walking pain, restoration of function.
SPRAINED ANKLES	Over the edematous area and tarsus, and around the terminal of the tibia and fibula in direct contact. If discoloration from hemorraghic sprain shows over the phalanges, treat this extremity under water.	.5 to 1	5 - 6				Immediate reduction of pain and of the edema followed by rapid restoration of function.
RHEUMATIC DISORDERS IN MUSCLES AND PERIARTICULAR TISSUES: —Lumbago —Torticollis —Muscular spasticity —Slipped disc —Epicondylitis —Tenosynovitis —Plexus neuralgia —Fibrositis	Apply to hypertonic muscles involved. (Direct contact, slow rotating motion).	.5 to 1	5 - 6	Corresponding nerve roots	.3 to .5	4 - 5	The objective is to diminish muscle tonus and spasticity to an asymptomatic condition, relief of pain and restoration of function.

SUBJECTIVE PAIN REPORTED BY PATIENT SHOULD NOT BE IGNORED, IT IS A SIGN OF TOO HIGH LEVEL OF POWER.

THE TECHNIQUES SUGGESTED ABOVE ARE A COMPILATION OF RECOMMENDED TREATMENTS BY A REPRESENTATIVE GROUP OF PHYSICIANS WHO SPECIALIZE IN THE FIELD OF PHYSICAL MEDICINE AND REHABILITATION. THE TECHNIQUES GIVEN HEREIN ARE INTENDED TO AID THE PHYSICIAN TO FAMILIARIZE THEMSELVES WITH ULTRASONIC TREATMENT; THEY ARE NOT NECESSARILY CONCLUSIVE THE ATTENTION OF THE PHYSICIAN IS CALLED TO THE PARAGRAPH ON CONTRAINDICATIONS CONTAINED IN OPERATING INSTRUCTIONS BOOKLET ACCOMPANYING THE INSTRUMENT.



Segmental extension
of surface sensibility
(incl. surface pain)
(Head)



Segmental extension
of visceral pain
(Lewis and Kellgren)

E X C E R P T S

from
Symposium on Ultrasonics
August 29, 1953
Palmer House, Chicago

Published in
American Journal of Physical Medicine
Vol. 33, No. 1, February, 1954

- - - - - - - - - - - - -

F. F. SCHWARTZ, A.B., B.S., M.D. (Assistant Professor of Clinical Medicine, Medical College of Alabama, Birmingham; consultant in Physical Medicine to V. A. Hospitals, Tuscaloosa, Alabama, Birmingham, Alabama and Jackson, Mississippi):

Conclusions

"From November, 1951, to August, 1953, 2911 ultrasonic treatments were administered to private patients at the Institute of Physical Medicine and Rehabilitation in Birmingham, Alabama . . . .There is no established dosage for Ultrasonics. Applications must be carefully made either in a water bath or on an oily surface. Ultrasonics is not a gadget. It must be used by experienced and trained persons. Conservative treatment is safer than heroic treatment with large wattage. Careful evaluation and selection of patients is important. Further research as to indications, contraindications and dosage with time of sounding is necessary. Ultrasonic therapy is a useful and valuable adjunct in Physical Medicine."

ARTHUR C. JONES, M.D. (419 Mayer Building, Portland, Oregon):

Comments and Summary

"Ultrasound therapy is a useful addition to physical therapeutics. Much more research in this field is necessary to understanding all of the mechanisms by which ultrasound produces physiological changes in biological systems. Dosage factors must be observed by all persons entrusted with the responsibility of ultrasonic therapy, in order to avoid known dangers of permanent tissue injury. Clinical benefits have been demonstrated in the use of ultrasound, added to standard therapeutic procedures, in selected cases of: bursitis, tendonitis, tenosynovitis, epicondylitis, rheumatoid arthritis, spondylitis of Marie-Strumpell type, some phases of hypertrophic arthritis, myositis, neuritis and radiculitis and painful neuromas. Satisfactory clinical results have been observed in the use of both continuous and pulsed ultrasound at a basic frequency of 1 megacycle, in dosages not to exceed 3 watts per square centimeter per second."

* * * * * *

H. J. BEHREND, M.D. and JEROME WEISS, M. D. (New York City):

Summary and Conclusion

"We have presented a resume of our clinical experience with this new method of treatment. We do not present extensive statistics, one can prove or disprove anything with statistical evidence. We feel that our clinical experience based on 6000 treatments given over a period of three and one-half years is consistent with the following conclusions. Ultrasonic therapy is a valuable form of treatment which is not dangerous within the therapeutic limits of accepted dosage in competent hands. Further investigation along the lines which we have indicated will undoubtedly establish firmly the value of ultrasonic therapy in geriatrics".

* * * *

LT. COL. JOHN H. KUITERT, M. C. (Brooke Army Hospital, Fort Sam Houston, Texas):

Conclusion

"Objective findings were relief of pain associated with increased range of motion of the affected segment and the peripheral joints innervated at the level of treatment. Side effects of ultrasonic energy appeared to be a nonspecific stimulation of the autonomic nervous system with local and general reactions which appeared rapidly and presumably traverse neural pathways. These reactions depended on the dosage employed and stationary sounding over a specific spinal root or segment. A conservative, calculated approach to ultrasonic therapy is indicated in selected pain syndromes associated with spinal root irritation of the mechanical type. The clinical efficacy of small doses of ultrasonic energy suggests that mechanical stimulation of the neural pathways may be the modus operandi in this form of treatment".

* * * *

JEROME W. GERSTEN, M.D. (Department of Physical Medicine and Rehabilitation, University of Colorado School of Medicine, Denver, Colorado):

Summary

"Good clinical results with ultrasonic energy have been reported by many workers in the treatment of muscle pain and spasm associated with fibrositis, osteoarthritis, scapulo-humeral periarthritis, slipped intervertebral disc, and similar disorders. On the average, good to excellent results were obtained in fifty to sixty percent of the patients with fibrositis, while fifteen to thirty percent were unimproved. There were fewer superior results in the treatment of osteoarthritis, with only thirty to thirty-five percent falling into this category. Accurate comparison of results with ultrasound and with other forms of therapy have been difficult to make. There is, thus far, neither

(Jerome W. Gersten, M.D., continued)

clear cut superiority nor inferiority in comparison with previously used technics. The value of ultrasound, at the moment, therefore lies in supplementing other forms of therapy for muscle disease. As far as the mechanism of action is concerned, there is evidence in the experimental animal that generalized heating of tissue, localized heating at interfaces, and non-thermal factors may all play a role in the effects noted in muscle and nerve after exposure to ultrasound. Though good clinical results have been obtained both with direct application over the involved muscle, and with radicular application over the appropriate nerve roots, there has been, thus far, no satisfactory evaluation of the two technics".

* * * * * *

BRUCE B. GRYNBAUM, M.D. (Assistant Professor of Clinical Physical Medicine and Rehabilitation, New York University Medical School; Director of Physical Medicine and Rehabilitation, Department of Hospitals, New York City, New York):

Conclusions

"A preliminary report is presented of one hundred cases treated with Ultrasonics. It is our impression from this series that this mode of treatment is of value in relieving pain and secondary muscle spasm of acute bursitis of the shoulder. Included in the above study are some observations on a series too limited in number to draw any final conclusions on the effect of Ultrasonics on other pathologic states. It is our intention to broaden the scope of this study. We fully realize that only prolonged clinical observations from many different medical centers can establish the true value of this new physical modality".

* * * * * *

JOHN H. ALDES, M.D., F.A.C.S., WALTER J. JADESON, B.S., R.P.T., and SEVERIN GRABINSKI, R.P.T. (Department of Physical Medicine and Rehabilitation, Cedars of Lebanon Hospital, Los Angeles, California):

Summary and Conclusions

"The present study is concerned with the clinical evaluation of a relatively new form of therapy. The methods and technics employed are described and the effectiveness of ultrasonic therapy is substantiated by means of statistical tables. A master chart serves to illustrate all results obtained during this study. Ultrasonic therapy does not only relieve pain and improve mobility but often also results in decrease of dissolution of calcifications, as demonstrated by roentgenograms. The response to ultrasonic radiation takes place more promptly in acute cases of subdeltoid bursitis, while chronic cases require longer and more intensive therapy. If calcareous deposits are present,

(John H. Aldes, M. D. et al, continued)

stationary treatment of the central portion of the deltoid muscle, directly below the acromial process, is of advantage. In the majority of patients, signs of improvement become apparent after four to six ultrasonic treatments. The range of motion is increased, and the tenderness and pain disappear gradually. A minimum of six treatments was given in each case. Even in the group of patients who had not obtained any, or only questionable improvement, and were classified under Grade 0, there were no ill effects from sonations. Undoubtedly, many cases of subdeltoid bursitis can be successfully treated by conventional methods. However, ultrasonic radiation would seem to be a more efficient means of alleviating pain and tenderness and restoring complete shoulder motion. Ultrasonic therapy, furthermore, shortens the duration of disability. In our opinion, ultrasound is not a substitute but rather an addition to the other modalities employed. A combination of ultrasonic radiation with other conservative methods has proved especially effective when patients failed to benefit from conventional treatment or ultrasonic therapy alone. As a result of the present study, ultrasound in combination with other modalities is now the procedure of choice in all cases of subdeltoid bursitis, resistant to other forms of conservative treatment".

* * * * * *

Use of Ultrasonic Radiation in the Treatment of Subdeltoid Bursitis With And Without Calcareous Deposits*

JOHN H. ALDES, M.D., F.A.C.S.
THOMAS KLARAS, B.S.
LOS ANGELES, CALIFORNIA

From the Department of Physical Medicine and Rehabilitation, Cedars of Lebanon Hospital

ABSTRACT

For the past three years, a clinical investigation has been made in the use of ultrasonic radiation in medicine. This clinical investigation was primarily on the use of this type of radiation in osteoarthritis.

During the past two years our investigation has included the use of ultrasonic radiation in the treatment of subdeltoid bursitis, with and without calcareous deposits.

We have compared this type of treatment with the conventional therapy for this condition and found the results are more effective with the use of ultrasound.

In this presentation we bring out the technical and therapeutic aspects of ultrasonics—the treatment procedures and their results of 210 cases treated with ultrasound that we have followed over a period of two years.

For many years subdeltoid bursitis, which has various synonymous titles, such as painful shoulder, subacromial bursitis, calcified bursitis, periarthritis, calcareous tendinitis and so forth, has been treated by many different methods. This particular condition has always been regarded as a difficult therapeutic problem; and whether chronic or acute, and with or without calcareous deposits, the types of therapy used were in line with medical progress at that time. The conventional therapies used for treatment were short wave diathermy, microtherm, electrotherapy, radiant heat, hot packs, novocain injections with hot saline flushes, roentgen therapy, and in some cases even surgery.

In 1938, when the senior author (J.H.A.) clinically evaluated all bursitis therapy known at that time, the conclusion reached was that diathermy or roentgen therapy were the most beneficial. Until the present time, little progress has been made in treating this condition.

During the past four years in the Department of Rehabilitation and Physical Medicine at the Cedars of Lebanon Hospital, we have conducted an investigation, both in clinic and laboratory, into the use of ultrasonic radiation for various diseases and disabilities.[1-3] Our early results showed that the physiological and biochemical effects of ultrasonic radiation were beneficial to many of the chronic orthopedic and neurologic conditions.

In December, 1950, ultrasonic radiations were given to a small controlled group of subdeltoid bursitis cases in order to compare this new modality with conventional forms of treatment. After promising results were obtained, a study on a greater number of cases was initiated in January, 1951, and is continuing at the present time. During this time 228 patients with subdeltoid bursitis, with and without calcareous deposits, were treated, of which 157 could be fully evaluated for the first two years. A preliminary report on this study was presented one year ago.[4] Since then we have treated another group of 58 patients, making use of the experience which we had gained in our initial study. Of this last group,

* Read before the Southern California Chapter of the American College of Surgeons, Santa Barbara, California, February 6 and 7, 1954.

Diplomate, American Board of Orthopaedic Surgery; Fellow, American College of Surgeons, American Academy of Orthopaedic Surgeons; Director, Department of Rehabilitation, Cedars of Lebanon Hospital; Chairman, Multiple Sclerosis Clinic, Cedars of Lebanon Hospital; Member, Medical Advisory Board of the National Multiple Sclerosis Society; Consultant, City of Hope Hospital, Duarte, California; Chairman, Western Section, American Congress of Physical Medicine and Rehabilitation; Member, numerous national and local Rehabilitation Committees. Formerly, Chief of Orthopedic Surgery and Chief of Rehabilitation, Birmingham Veterans Hospital, Van Nuys, California. Lt. Colonel, United States Army Medical Corps, Chief of Orthopedic Surgery and Rehabilitation during World War II.

53 could be evaluated. We are now presenting our total results and conclusions on the 210 cases we were able to follow for at least three years.

Technical and Therapeutic Aspects of Ultrasound. Ultrasonic waves have a frequency above that of audible sound and are usually produced by the piezoelectric crystal method. The ultrasonic generator consists mainly of a high-frequency circuit, an oscillator circuit, and a quartz crystal which is the integral part of the hollow metal applicator. By exposing opposite sides of the quartz crystal to an alternating electric field, the crystal is caused to vibrate, and the resulting ultrasonic vibrations are transmitted to the front plate of the treatment head. Ultrasonic waves will not travel through a vacuum, and transmission through air is ineffective. A coupling agent, such as an oil of high viscosity, or

Figure 1

Figure 2

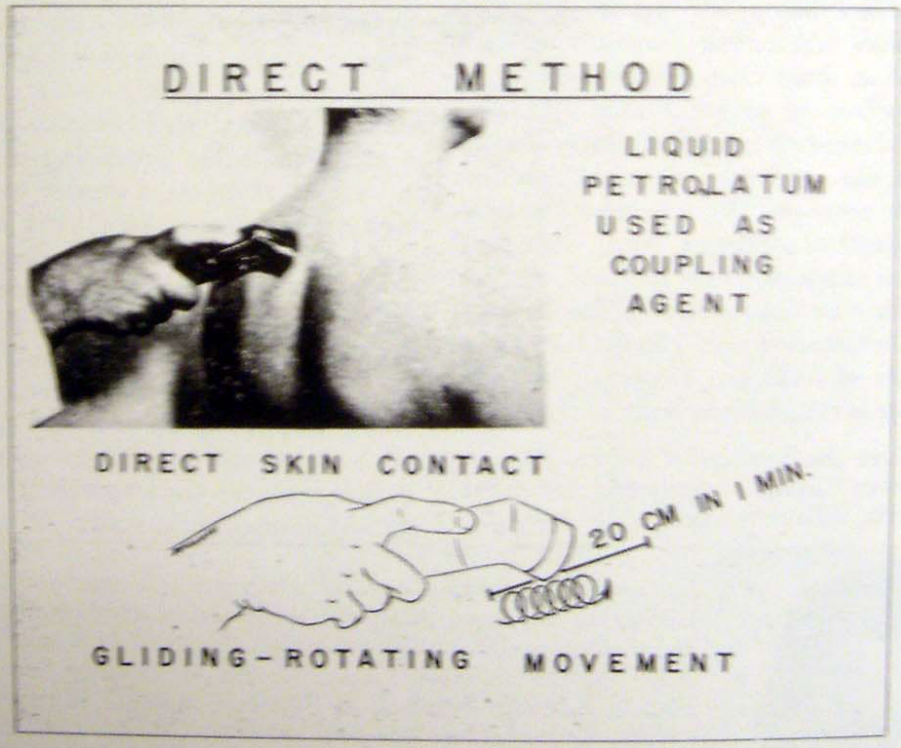


Fig. 1. Showing anatomical areas and position of patient for application of ultrasonic radiation.
Fig. 2. Direct method of application of ultrasonic radiation.

water is, therefore, necessary between treatment head and the area to be treated.[1-7]

At the optimal frequency of 800,000 or 1,000,000 cycles per second, a layer of tissue two to six centimeters deep may be reached by ultrasonic waves. The effect decreases with depth because of reflection, refraction, or absorption in the tissues. Important factors are the coupling medium, the absorption coefficient of the specific tissue, and the ultrasonic intensity applied.

Very high intensities may greatly affect the molecular structure of the tissues and cause damage or even necrosis, as demonstrated in animal experiments. The Arndt-Schultz principle holds true, that weak stimuli excite living processes, while strong stimuli are destructive. Consequently, only low intensities were used in our evaluations but the energy produced was, nevertheless, considerable.[8,9]

Most important among the numerous biochemical, biophysical and physiological effects of ultrasonic radiation is the powerful micromassage to which the cellular tissues are subjected. These mechanical vibrations increase active blood supply, influence the sympathetic and parasympathetic nervous system, stimulate metabolism, and produce an analgesic effect. Frequently the skin becomes hyperemic. A significant secondary thermal effect is observed, comparable to that of local short-wave diathermy.[8,10,11]

Further results include degassing action and intensification of gas exchange through increased membrane permeability; breaking up of tissue deposits and promotion of their absorption; acceleration of lymph flow; destruction of bacteria; and changes in blood chemistry. These and numerous other physical and biological effects cannot be separated, but they all play a certain role in improving mobility and relieving pain.[1,7,10,11]

We are all familiar with the anatomical position of the subdeltoid bursa and the pathological conditions in the various stages of

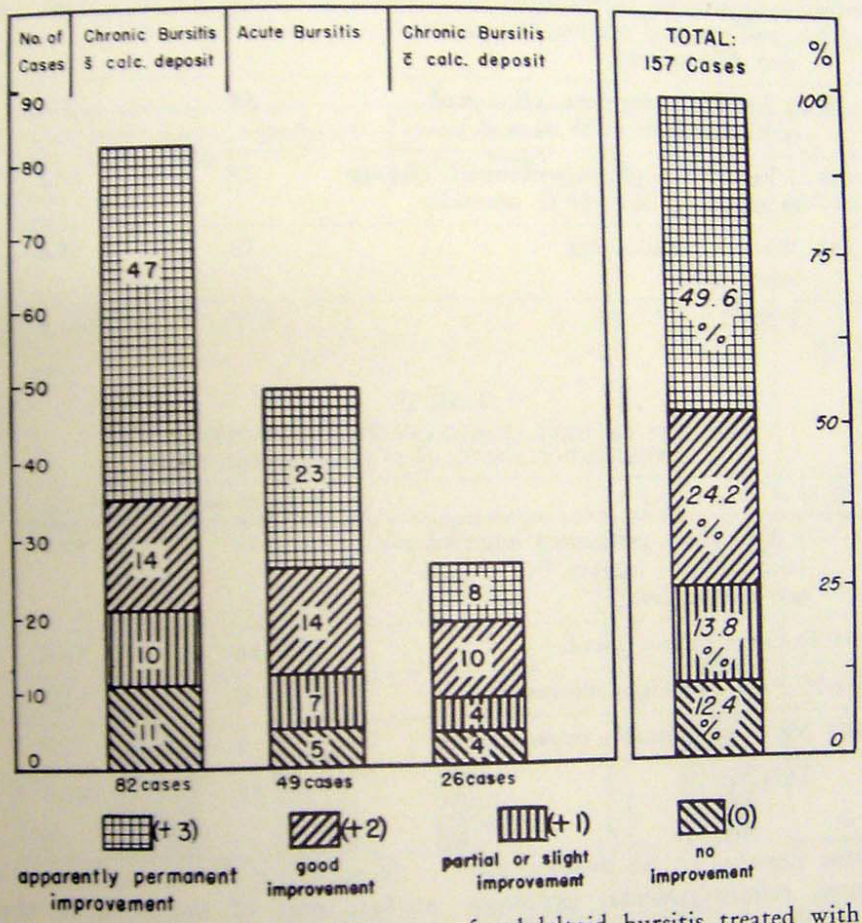


Chart I. Total results in 157 cases of subdeltoid bursitis treated with ultrasonic radiation.

bursitis, as well as the accompanying objective and subjective findings.[12-14] In treating subdeltoid bursitis with ultrasonic radiation, we find that it produces a powerful and deep micromassage, exerts localized thermal action, and increases intracellular metabolism; it causes exudates and precipitates to be absorbed and tissue deposits to be broken up; it loosens tissues, relieves edema, decreases hypertonicity of the muscles, and produces a local analgesia causing an immediate relief of pain.[3,4,7]

Table I

TOTAL RESULTS AFTER USING COMBINATION THERAPY FOR ALL (0) AND (+1) GROUPS

Grade of improvement	No. of cases	Per Cent
(+3) Apparently permanent improvement. (full range of motion, loss of pain and discomfort)	82	52.2
(+2) Good improvement. (Range of motion at least 80% normal.)	44	28.0
(+1) Partial or slight improvement. (Range of motion at least 50% normal.)	19	12.2
(0) None or questionable improvement	12	7.6
TOTAL	157	100.0

Table II

RESULTS OF ULTRASONIC COMBINATION THERAPY IN SUBDELTOID BURSITIS IN 53 ADDITIONAL CASES

Grade of improvement	No. of cases	Per Cent
(+3) Apparently permanent improvement. (full range of motion, loss of pain and discomfort.)	28	52.8
(+2) Good improvement.	16	30.2
(+1) Partial or slight improvement.	6	11.3
(0) No or questionable improvement.	3	5.7
TOTAL	53	100.0

Treatment Procedures. Prior to the application of ultrasonic radiation, it is important that in addition to the physical and laboratory examinations, x-rays be taken of the cervical spine and shoulder joint to rule out any contraindicated pathology and confirm the possibility of a calcareous deposit in the subdeltoid bursa.

In applying ultrasonic radiation for the treatment of subdeltoid bursitis, the area to be radiated is divided into three zones: (1) the cervical region; (2) the suprascapular region; and (3) the deltoid area.

In our application, we follow the radicular and neurotrophic technics of Tschanmen, and Stuhlfauth[15] in which we sonate not only the local area of the subdeltoid bursa, but also the nerve roots of the cervical plexus.

In sonating the cervical roots, we place the surface area of the head of the transducer paravertebrally, just adjacent to the transverse processes.

The next region to be treated is the suprascapular and trapezius muscle area, following which radiation is applied to the entire deltoid muscle group with emphasis on the subacromial region. We then radiate down to the insertion of the deltoid muscle (Fig. 1). In our experience we have found that the best position for the patient for the application of ultrasonic therapy is to place him in a sitting, relaxed, kyphotic attitude of the cervical and upper dorsal area.

A coupling agent of heavy liquid petrola-

tum is used and is applied generously over the skin area to be radiated as well as over the source of energy, which is the flat surface of the head of the transducer. Firm contact must be made between the flat surface of the transducer and the skin, and radiation is applied with a gliding or massage technic, using slow circular movements of the sound head. A distance of not more than 20 cm. is covered in one minute, and this procedure is repeated until the entire surface to be treated has been reached (Fig. 2).

The frequencies we used were either 800,000 or 1,000,000 cycles per second and the intensities of 0.4 to 1.5 w/cm.^{2} The intensity used for the first few applications was between 0.4 and 0.8 w/cm.^{2} After the first three sonations, the patient's symptoms were reevaluated and the intensity adjusted accordingly. Whenever there is no improvement in the patient's condition, yet no increase of pain, a higher energy output is advisable. On the other hand, if the pain has increased, the energy output must be reduced. The intensity never exceeded 1.5 w/cm.^{2}

Subdeltoid bursitis should be treated by low intensities; high intensities in the majority of cases not only produce little beneficial effect, but may aggravate the condition. Low intensities applied with good technic and proper precautions seldom create a painful reaction.

Usually the patient experienced a temporary flare-up of pain a few hours after sonation, and as a precaution it was best to supply the patient with a pain-relieving drug. In our experience, such a reaction was usually a sign that the patient would benefit more quickly than if no pain had occurred. As a rule, such flare-ups of pain disappeared after a short while. Pain occurring during radiation is an indication that either the intensity is too high, or that insufficient coupling agent is being used.

The duration of time for each sonation was usually from three to five minutes over each

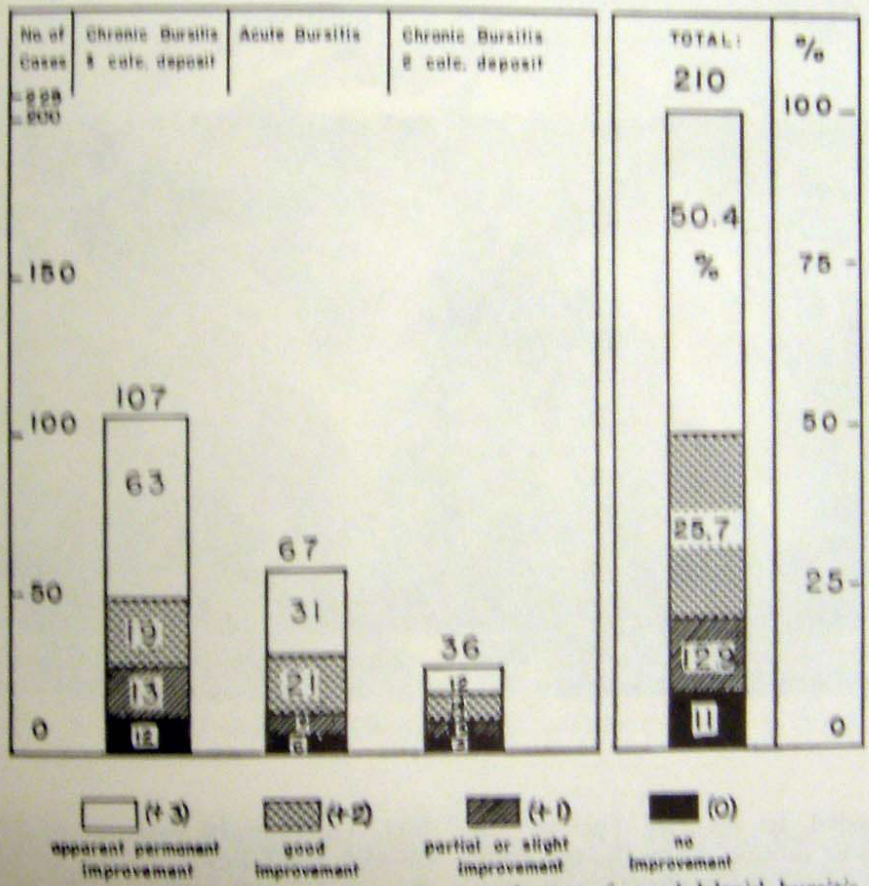


Chart II. Results of ultrasonic radiation therapy for subdeltoid bursitis in 210 cases.

of the three anatomical areas. In the acute cases, sonation was given daily; in the chronic, every other day. It has been our experience that a minimum of six sonations is required before beneficial results can be expected, but a full course generally consisted of nine to twelve treatments.

A rest period of two weeks followed the first series of sonations, and if symptoms persisted, which was rare, a second series of six sonations was then given. If necessary, a third and even a fourth series was administered after rest periods between each series.

Although in our series the majority of our patients received dramatic relief from pain and experienced a steady increase in the range of motion in their shoulder after only a few sonations, we still advised a program of home exercises designed to increase further the range of shoulder motion. Even though additional soreness may have resulted, such exercises were invaluable in preventing residual stiffness of the shoulder. But important as they may have been as an adjunct to ultrasonic therapy, exercises by themselves would not have improved the condition.

In the treatment of subdeltoid bursitis with calcareous deposit, stationary sonation was applied, in addition to the gliding technic, directly over the area where the deposit occurred. For the stationary application, both intensity and duration were greatly reduced, and only 0.1 to 0.25 w/cm.^{2} was administered for a period of one to three minutes.

RESULTS

In our series, 70 per cent of all patients had been previously treated by conservative methods such as infra-red heat, hot packs, diathermy, microwave, saline flushes and roentgen therapy without satisfactory results.[16] Beside using this group as a control, we took another group, similar in every respect, and repeated the conservative treatment in order to compare our results (Chart I).

In our first series of 157 cases which we have been able to follow for at least two years after their last radiation, 78 patients, or 49.6 per cent, showed apparently permanent improvement (+3). These patients had a full range of motion and loss of pain and discomfort. Thirty-eight patients, or 24.4 per cent, showed good improvement (+2), and these showed loss of pain and discomfort and at least 80 per cent of normal range of motion. There were 21 patients (13.8 per cent) who showed partial or slight improvement (+1), and these individuals, although having no pain or discomfort, still had a range of motion of only 50 per cent of normal. There were 20 patients, or 12.4 per cent, who showed no, or questionable, improvement (0). In our first series of cases of chronic and acute subdeltoid bursitis, with and without calcareous deposit, we were able to show that 116 patients, or

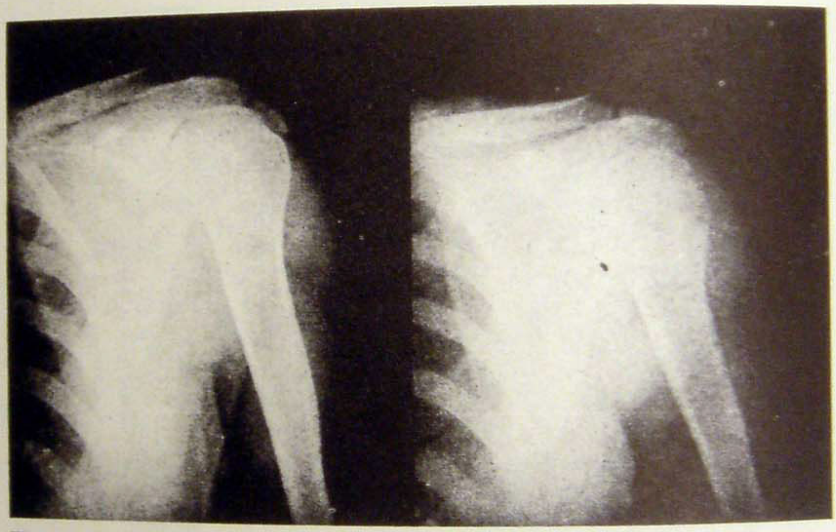


Fig. 3. X-rays of shoulder; chronic subdeltoid with calcareous deposit before and after ultrasonic radiation.

73.8 per cent, showed apparently permanent or good improvement, and 41, or 26.2 per cent, showed partial, slight or no improvement.* Of the 41 patients who obtained little or no improvement from either ultrasonic or conventional therapy, 35 were given another series of ultrasonic treatments, starting and terminating the treatment this time with infra-red heat, or hot packs when muscle spasms were present. These patients who had reacted poorly to conventional or ultrasonic therapy when either one of these forms of treatment was given independently, showed ing partial or slight improvement (Table II and Chart II).

In our group of 210 patients, there were 36 who had subdeltoid bursitis with calcareous deposit. Of this group of 36, 48 per cent showed either complete disappearance or decrease of the calcareous deposit following ultrasonic therapy. Our findings indicate that no constant relationship exists between the decrease or disappearance of calcareous deposit and improvement of symptoms of bursitis (Fig. 3). Most patients experienced relief after the deposit had been reduced

Fig. 4. X-ray of shoulder showing chronic subdeltoid bursitis with calcareous tendinitis.

that good results could be achieved by a combination of these treatments.

By recalculating our statistics following the combination therapy in this small group, we were able to raise our permanent or good improvement from 78.8 to 80.2 per cent and thus lessen our partial or slight improvement to 19.8 per cent (Table I).

In continuing our series by adding 53 more patients and using a combination therapy of ultrasound with infra-red and hot packs we were able to show a further increase to 83 per cent in our permanent or good improvement group with only 17 per cent experiencing (Fig. 4), but we found that ultrasonic radiation may be effective even when the deposit failed to show any response.

SUMMARY

1. This study was concerned with the clinical evaluation of ultrasonic therapy compared with the conventional types of therapy for chronic and acute subdeltoid bursitis with and without calcareous deposits.

2. A brief discussion was presented as to the physical, physiological and biochemical properties of ultrasonic radiation.

3. Methods and technic of application of

ultrasonic radiation in the treatment of subdeltoid bursitis were explained.

4. Statistical data were presented showing the results obtained in 210 cases over a three year period.

5. Conclusions of this study showed that this new form of therapy (ultrasonic radiation) not only was more effective alone than conventional forms of treatment, but in combination with conservative methods proved most effective.

6. In treating these 210 patients we gave over 5,040 sonations and we did not note any ill effects to the patient or any adverse pathologic changes in the repeated blood, urine and x-ray examinations.

7. As a result of this study, it is our opinion that ultrasonic radiation alone, or in combination with other conventional methods is the procedure of choice for the treatment of subdeltoid bursitis, with or without calcareous deposit.

REFERENCES

1. Aldes, J. H. and Judeson, W. J.: Ann. West. Med. & Surg., 6:545, September, 1952.
2. Aldes, J. H. and Judeson, W. J.: Ultraschall in der Med., 5:107, September, 1952.
3. Aldes, J. H. and Judeson, W. J.: Ultrasonic Therapy in Medicine: Indications and Contraindications, Arch. Phys. Med. & Rehab. Accepted for publication, Am. J. Physiol. Med.
4. Aldes, J. H.; Judeson, W. J. and Grabinski, S.: Am. J. Phys. Med., 33:76, February, 1954.
5. Zobel, A.: Ultraschall in der Med., 1:29, 1949.
6. Uber, F. M.: Biophysical Research Methods, Interscience Publishers, New York, 1950.
7. Lehmann, J. F.: J. Acoustic. Soc. Am., 25:27, January, 1953.
8. Nelson, P. A.; Herrick, J. F. and Krusen, F. H.: Arch. Phys. Med., 31:6, January, 1950.
9. Bergmann, L.: Der Ultraschall und seine Anbwendung in Wissenschaft und Technik, S. Hirzel Verlag, Leipzig, 1950.
10. Pohlman, R.: Die Ultraschall-Therapie, Hans Huber, Bern, 1951.
11. Buchtala, V.: Schweiz. Med. Wchnschr., 79:472, May 7, 1949.
12. Morris H.: Human Anatomy, Blakiston Co., New York, 1942.
13. Cecil, R. L.: Medicine, W. B. Saunders Co., Philadelphia, 1940.
14. Christopher, F.: Textbook of Surgery, W. B. Saunders Co., Philadelphia, 1942.
15. Stuhlfauth, K.: Brit. J. Phys. Med., 11:10, January, 1952.
16. Mock, H. E.; Pemberton, R. and Coulter, J. S.: Principles and Practices of Physical Therapy, W. F. Prior Co., Hagerstown, Maryland, 1946.

Reprinted from
The Western Journal of Surgery, Obstetrics and Gynecology
Vol. 62, pp. 369-376, July, 1954

PRINTED IN U.S.A.

ULTRASONIC THERAPY:

A Review of Its Present Status and Future Possibilities

KENNETH PHILLIPS, M. D. F.A.C.P.

Miami, Florida

Introduction

Sales resistance to change or something new, is an inherent characteristic of the human race. The psychology of man is so constructed that his first impulsive reaction to something new is "what's wrong with it?". Clinicians are not exceptional; in fact, they are sometimes dogmatic in opinion regardless which side of a question they choose. We may, therefore, logically anticipate that ultrasonic energy will undergo a considerable mental and verbal mauling while it is gaining its birthright.

High frequency sound energy is not new. Wood and Loomis (1), two American physicists, reported biological studies with it in 1927. Industrially, ultrasonic energy is being applied with increasing magnitude; but its application to diagnosis and therapy has been slow and comparatively recent. Wide study and reports by recognized scientists in Europe, and those now appearing from American investigators, supply discussions and cases running into thousands, and justify some evaluation and conclusions.

The scope intended here will cover: (1) A brief outline of the clinical physics, and technical phases; (2) Accepted biological effects; (3) Clinical application and case studies; and (4) Imparttal discussion with references covering significant phases of the subject.

Physics and Technical Phases

Therapeutic ultrasound waves are a special kind of acoustical energy, much higher in frequency than audible sound. They are produced in, and emitted from, a transducer or soundhead in which is anchored a section of quartz cut in a special way from a large crystal of natural quartz. Quartz possesses piezoelectric qualities when placed in a high frequency electrical field, and in turn emits ultrasonic vibrations from the soundhead. Ultrasonic waves will not travel in air, and can be transmitted only through solid or liquid material, technically called a "Coupling". They can be "beamed" although they are not radiation in the sense of x-ray or radium. The energy is not electrical, and not chemical, although it is believed that chemical reactions are accelerated by ultrasonic application.

Soundheads of different instruments may vary in size, shape, crystal dimensions, etc., but the underlying principle is the same. Actual energy output to the part treated, however, may be different depending upon the engineering design of the soundhead and crystal dimensions. Instruments used in our work (Lindquist Chronosonic) are designed to operate at a frequency of 920 kilocycles per second, with a crystal area of eleven square centimeters. The actual contact area of the soundhead is somewhat larger than the crystal. Total power output of pulsed acoustic energy is adjustable in 10 steps of control, from 1/4 watt to a maximum of 12 watts.

Technical application of the transducer is not complicated. Coupling with oil or water between the soundhead and skin is essential since the slightest column of air will prevent transmission of the energy. Extremities and irregular areas lend themselves to treatment under water, during which the face of the soundhead is immersed and kept in motion about one-half inch from the skin. Two applications have been advocated; stationery, and movement method. The latter only (slow rotary, stroking, etc.) is used by the author.

Biological Effects

Because ultrasound is a new and different therapeutic energy, one expects variation in opinion relative to its biological effects. However, I see no justifacation for the "alarm reaction" and the brand of "danger" tacked on by a minority group of workers. Certainly it goes without emphasis that anyone using or working with this energy should be thoroughly grounded in its fundamentals. I have been unable to find any record, written or oral, where within the intensities prescribed for therapeutic use, anyone has been able to produce tissue destruction without first exceeding the physiological pain threshold. What other physical modality gives the therapist such a safety valve? Full cognizance is given current experimental work at higher intensities on mice and other anaesthetized animals; but to date, in the hands of capable workers, and within the therapeutic dosage advocated by leading authorities, there is no reason for considering ultrasonic energy "dangerous and unsafe". Extensive reports from leading authorities presented at the 3rd. International Congress at Bad Ischl (recently translated in English) (6), DeForest et al (7), Licht (14), and Lehmann & Herrick (8) studying effects on tissues in small animals, offer wide information relative to the safety problem.

Many biological effects of ultrasonic energy are now known. That it offers "good beaming" and "high depth penetration", is apparently accepted. High absorption in muscle as compared to fat, give it advantage over present modalities, and bone can be penetrated. Research opinions differ relative to the thermal element of ultrasonic energy. Schwan and Carstensen (2), in a brilliant report, evaluate the thermal factor; while European scientists of renown,

Van den Bosch (3), Pohlman, Stuhlfauth, Buchtala, Tschannen, and others (4) clearly open the gate for an opinion that heat as such is an indirect, and clinically speaking, probably a minor factor. Zach of Vienna (15) has concentrated a part of his studies on the athermal effects of this energy; and certainly water placed on the soundhead can be vaporized, but the vapor is cold - not hot steam.

Extensive research by Europeans; work in progress by Rosenthal (5), in New York, on proteins, minerals, fats, sugars, etc., all reveal evidence of biologic effects other than thermal. Intracellular metabolic effects, analgesia, microcellular vibration, action on nervous, blood, and lymph systems have all been included in the biologic survey.

The specific behavior of ultrasonic reflections in relation to density of tissue, has initiated studies of this energy as a diagnostic agent. Results at present are empirical.

Clinical and Treatment Application

Many clinical entities have been treated with ultrasonic energy. (4) (5) (6) (8). Results reported have varied, but in the overall have been encouraging. From the vast clinical literature surveyed, a grouping or classification of diseases is difficult. Arbitrarily, however, it is helpful to consider acoustical energy as applied to three large groups: 1. Clinical conditions which involve the autonomic nervous system, including peripheral vascular disease; 2. those engendering bone and joints, (arthritides, radiculitis, discs, and acute trauma); and 3. distress and pain syndromes involving bursitis, neuralgias, neuritis, fibrositis, and functional low back distress. Miscellaneous conditions under study, and more specific than this grouping will not be included in this report.

TABLE I

CONSTRUCTED TO PRESENT SUMMARY PICTURE OF SEVERAL DISEASES TREATED WITH ULTRASONIC ENERGY.

Clinical Group	Total Cases	Sex	Age--Range in years	Duration of Complaint	Previous Therapy	RESULTS: None	Moderate	Good
Autonomic Nervous System								
Bronchial Asthma	3	F-3	17 to 50	8 to 20 years	Conventional all failures including ACTH, etc.	1	1	1
Circulation Disorders Legs - Skin - Ulcers	10	M-4 F-6	61 to 86	6 Mos. - 5 yrs.	None - Routine - Some surgical	2	4	4
Gangrene Toes	5	M-2 F-3	39 to 62	3 wks. - 1 yr.	Conventional all failures	1	1	1
Bones and Joints								
Acute Trauma: Joints, Back and Fractured Ribs	72	M-52 F-20	17 to 46	2 hrs. - 2 wks.	None to usual first aid	8	12	52
Radiculitis	10	M-6 F-4	27 to 42	2 mos. - 6 mos.	Various including ACTH	4	3	3
Arthritis: Rheumatoid Osteo, and Mixed Types	130	M-38 F-92	41 to 78 Aver.55	5 to 40 years	92% failures with modern therapy including Cortisone, ACTH and B 12	77	38	15
Disc Syndrome	0					0	0	0
Disc Syndrome Van Went, Amsterdam, Holland	34	M-10 F-24	18 to 61	Not Reported	Not Reported	2	-	32
Pain and Distress Syndromes								
Acute Bursitis	10	M-9 F-1	32 to 51	24 hrs.-5 days	Injection - Heat	-	-	10
Chronic Bursitis	5	M-4 F-1	27 to 43	1 yr. - 8 yrs.	Various - X-Ray - Needling	2	3	-
Myofibrositis	20	M-11 F-9	31 to 47	2 wks. - 1 yr.	Multiple	5	10	5
Low Back Distress - Functional	22	M-14 F-8	28 to 53	3 hrs. - 1 wk.	Indefinite	4	3	15
Neuralgias - Neuritis, Herpez Zoster	5	M-2 F-3	32 to 55	5 days - 3 yrs.	Indefinite	5	-	-
Multiple Sclerosis	2	M-1 F-1	32 to 65	2 - 7 yrs.	Usual Routine	2	-	-

A definite technique of application and dosage was established from the beginning, and was applied in all cases, regardless of group, with the exception of two rules applied to any individual case. 1. When local distress was manifest, intensity was reduced; 2. in acute conditions, if aggravaion resulted, then both intensity and duration of treatment was reduced. Coupling used was either oil or water, only movement or rotary technic was used, treatment time to each area eight to ten minutes daily, or three times or twice weekly, depending upon the severity of the complaint. Total number of treatments varied with clinical response and ranged from three to fifteen. In Arthritis, one-third of the treatment was given over the spinal area supplying the nerve roots to the peripheral parts affected, and two-thirds to the joint areas themselves.

Cases Studied

The clinical study was carried on in two separate departments with trained operators in each. Individual evaluations were tabulated by operators, then the aggregate surveyed between supervisor and patient, and lastly a final analysis and ratio breakdown of results.

A total of 294 cases have been treated over a period of nine months. Ages ranged from fourteen (only three between fourteen and twenty) to eighty-six years. The majority fell between forty and sixty-five years. Average number of treatments per patient was eight; significant mostly in justifying therapeutic safety, since in the total of 2,352 treatments given, not one severe local or systemic reaction occurred. Sex represented 123 males, 171 females.

Table No. 1 is constructed to summarize significant clinical data and results. It is recognized that when evaluation of results is dependent upon objective and subjective measurements by both patient and physician, a margin of uncertainty must exist. However, with the system of independent recheck established, it is felt that an accurate trend is shown by the method selected in rating improvement as none, moderate, or good.

General Discussion

Table No. 1 presents an aggregate picture, the results column of which forms only a part. Challenge on certain points is anticipated, and elaboration is indicated in attempt to further clearify the table as a whole. The objective of the study and report must be comprehended. Our purpose is an attempt to evaluate ultrasonic energy as a new and different therapeutic agent in clinical medicine; and not to test its function against any one specific disease or complaint. This supplied the reason for reporting on only a few cases in certain complaints. A trend toward positive or negative general value is the motive; not specificity. Additional perspective can be gained by closer detail study of the table with respect to each group. Certainly from a strict scientific viewpoint, three cases of Bronchial Asthma is meaningless; but when one observes the duration of the complaint together with the fact that they were all miserable failures under all previous therapy including ACTH, the complexion changes. Furthermore, Buchtala, Stuhlfauth, and Sholz (4) have reported favorably on a more extensive study in Asthma.

Likewise, in other complaints reported on only a few cases, the entire table must be studied if the significant trend is to be apprehended. The vascular ulcers were all previous failures some of five years duration; and all of the cases of gangrene of foot or toes were ready for surgical amputation when ultrasonic therapy was started. Even the one classified as a failure has not yet gone to amputation (five months), but other emergency measures were instituted and therefore clouded the issue. Study of the age range in the table is significant.

Any criticism for not classifying the arthritic group separately is answered as follows. This was a study in therapy; not etiology. The symptoms demanding relief in this disease are pain, progress of disability, and crippling, regardless of type. The challenge to the therapist is the same in all types, and there is good reason for contending that while we have been spending so much time researching the phases of etiology and types, eight million of these sufferers still remain on the waiting list for symptomatic relief. A first glance at the table revealing 77 failures in 130 cases is not impressive; but further study showing that 92% of the total were complete failures to all modern therapy at the outset, again changes the complexion of interpretation. In other words, we chose the hopeless cripple for the experiment.

In summary, if our study reveals any outstanding value of ultrasonic energy over present established methods of therapy, it would be in acute bursitis, traumatic sprains to joints, and functional low back distress. This statement may bring scientific rebuff from Krusen, Herrick, Lehman et al based on their reports (7) (8) on mice, rabbits, and dogs; but clinically these results have been tested and they are sound. Technical and experienced application in these conditions is emphatically important. A current report by Teppenberg and Marjey (13) is interesting.

With specific reference to intervertebral disc syndrome, it will be noted that we have treated none. However, the reports of studies by Van Went (6) (11) in Amsterdam, Holland are of such importance that they are included in the table. Her studies have been wide and deep; and soon, we are hoping a book under her authorship will be published. Friedland, et al (16), an American pioneer in clinical ultrasonics, treated 29 cases of herniated discs in 1951, with only 4 cases receiving definite relief. Obviously, his study was during early days, and possibly later studies may be more favorable.

Postulation and prophecy relative to ultrasonic phenomena is, of course, intriguing. The minute sonar "pip" on the screen, which meant so much in submarine location during a critical wartime, may well locate a gall stone in the future. The extensive studies of Travell et al (10) on trigger areas and the genesis of pain opens an additional possibility to ultrasound application.

Conclusions

1. Ultrasonic energy, as a therapeutic agent, adds a new modality to present physical equipment.
2. It has been sufficiently tested to assure its safety providing its use is by those properly trained in basic fundamentals.
3. Results of this study, together with voluminous reports from European and American scientists, justify an opinion that this energy offers wide future possibilities.
4. The most outstanding therapeutic results of this study have been with traumatic injuries, acute bursitis, and low back distress. Other conditions have been discussed.
5. As a diagnostic agent, studies are empirical but indicate possibilities of much future value.

References

1. Wood, R.W., and Loomis, A.L., Physical and Biological effects of high frequency sound waves of great intensity. Physiol. Rev., (Am.) 29: 417, 1927.
2. Schwan, H.P., Carstensen, E.L., Advantages and Limitations of Ultrasonics in Medicine. J.A.M.A. 149: No. 2, May 10, 1952.
3. Van den Bosch, F., Ultrasonics and Therapy. Radio-Electronics, Nov. 5, 1951.
4. Ultrasonics, British Jour. Phys. Med., (entire issue) 15: No. 1, Jan. 1952.
5. Rosenthal, Harry., Ultrasonics in Clinical Medicine. Jour., Aviation Medicine, 21: No. 3, June 1950.
6. Eckel, K., Lettowsky, F., Lindquist, R.J., Report International Medical Ultrasonics Congress, Bad Ischl, Austria, Sept. 7-10, 1952, U.S.A. Copyright, 1953.
7. DeForest, R.E., Herrick, J.F., Janes, J.M., Krusen, Frank, H., Effects of Ultrasound on Growing Bone. Arch. Phys. Med & Rehab., 34: No. 1, Jan. 1953.
8. Lehmann, J.F., Herrick, J.F., Biologic Reactions to Cavitation, A Consideration for Ultrasonic Therapy. Arch. Phys. Med & Rehab. 34: No. 2, Feb. 1953.
9. Schwartz, F.F., Ultrasonics in Arthritis. Jour. Med. Assoc. Alabama, Jan., 1953.
10. Travell, Janet, & Seymour, H.R., The Myofascial Genesis of Pain. Postgraduate Medicine, 11: No. 5, May, 1952.
11. Van Went, Johanna M., Diseases of Spine Treated with Ultrasonic Waves. Brit. Jour. Phys. Med., 14: No. 6, June 1951. ibid: May, 1952.
12. Newman, M.K., Murphy, A.J., Ultrasonics in Chronic Rheumatic Diseases. Jour. Mich. State Med. Soc., 51: 1213, Sept., 1952.
13. Teppenberg, I., Marjey, E.J., Ultrasound Therapy of Painful Neurofibromas. Am. Jr. Phy. Med. 32: Feb. 1953.
14. Bierman, Wm., and Licht, Sidney., Physical Medicine in General Practice, 3rd, Ed. Paul B. Hoeber Inc., New York.
15. Zach, Franz S., The Action of Ultrasonic Energy on the Autonomic Nervous System. British Jour. Phys. Med., 15: No. 11, 256-63, Nov. 1952.
16. Friedland, Fritz, Bisgrove, J.G., and Doyle, B.J., Therapeutic Application of Ultrasonic Energy. Arch. Phys. Med. 33: No. 8, Aug. 1952.

Read before the annual meeting of the Florida Medical Association at Hollywood Beach, Fla. April 26, 1953.

Jackson Memorial Hospital
Miami, Florida

PARTIAL LIST OF USERS OF H. G. FISCHER & CO.
MODEL NO. 6 ULTRASONIC GENERATORS

Speir Hospital, Greenville, Ala.

Hartselle Hospital, Hartselle, Ala.

De Witt Clinic, De Witt, Ark.

Labor Medical Clinic, Inc.
Washington, D. C.

Walker Memorial Sanitarium & Hospital
Avon Park, Fla.

University of Florida Athletic Department
Gainesville, Fla.

Immokalee General Hospital, Immokalee, Fla.

Osceola Hospital, Kissimmee, Fla.

St. Joseph Hospital, Bloomington, Ill.

General Electric Co., Bloomington, Ill.

University of Illinois Athletic Department
Champaign, Ill.

University of Illinois Student Clinic
Champaign, Ill.

Oak Forest Infirmary, Oak Forest, Ill.

Bradley University Athletic Department
Peoria, Ill.

Forest Park Home, Peoria, Ill.

Institute of Physical Medicine and
Rehabilitation, Peoria, Ill.

Carle Memorial Hospital, Urbana, Ill.

Indiana University Athletic Department
Bloomington, Ind.

Our Lady of Mercy Hospital, Dyer, Ind.

Veterans Administration Hospital, Marion, Ind.

Cresco Medical Clinic, Cresco, Iowa

Clinic Hospital, Dexter, Iowa

Schwab-King Clinic, Overland Park, Kan.

Osteopathic Clinic, Winfield, Kan.

Marine Hospital, Louisville, Ky.

Rehabilitation Center, Inc.
Louisville, Ky.

Glen L. Martin Co., Baltimore, Md.

Mercy Hospital, Benton Harbor, Mich.

Art Center Hospital, Detroit, Mich.

Lincoln Clinic, Detroit, Mich.

Bianco, Martin and Smith Medical
Laboratory, Duluth, Minn.

St. Mary's Chronic Illness Hospital
Duluth, Minn.

Physical Rehabilitation Group
St. Barnabas Hospital, Minneapolis, Minn.

University of Minnesota Medical Schools
Minneapolis, Minn.

Aberdeen Hospital, Aberdeen, Miss.

Orthopedic Physical Therapy Clinic
Kansas City, Mo.

Blair Clinic, Blair Nebr.

Dodge County Memorial Hospital
Freemont, Nebr.

University of Nebraska Athletic Dept.
Lincoln, Nebr.

University of Nebr. Field House, Lin.N.
Benson Medical Center, Omaha, Nebr.

Dundee Medical Clinic, Omaha, Nebr.

Nebraska Methodist Hospital, Omaha, Nebr.

Swift & Company, Omaha, Nebr.

V.A. Hospital Bronx Research Department
Bronx, N.Y.

Mountain Sanitarium, Fletcher, N.C.

Lenoir-Rhyne College, Hickory, N.C.

Gordon Crowell Memorial Hospital,
Lincolnton, N.C.

G and M Medical Clinic, Shallotte, N.C.

Akron General Hospital, Akron, Ohio

St. Francis Hospital, Cambridge, Ohio

Republic Steel Co., Canton, Ohio

Industrial Emergency Hospital, Cleveland, O.

Ohio College of Chiropody, Cleveland, Ohio

Republic Steel Co., Cleveland, Ohio

Marting Hospital, Ironton, Ohio

Marietta Osteopathic Clinic, Marietta, O.

The Hoover Co., North Canton, Ohio

Detroit Steel Corp., Portsmouth, Ohio

U. S. Steel Corp., Fairless Hills, Pa.

Lankenau Hospital, Philadelphia, Pa.

Pottsville Hospital, Pottsville, Pa.

Reed Mock Clinic, San Juan, Texas

St. Barbaras Clinic, Colonial Beach, Va.

Tucker Clinic, Williamsburg, Va.

Clausing Clinic, Seattle, Wash.

Kraable Clinic, Seattle, Wash.

McNeish Clinic and Hospital, Elkins, W.Va.

Main Street Gilmer Clinic, Glenville, W.Va.

Tucker County Hospital, Parsons, W. Va.

Webster County Memorial Hospital
Webster Springs, W. Va.

Hazel Green Hospital, Hazel Green, Wis.

Shullsburg Memorial Hospital, Shullsburg
Wisconsin

Medical College Hospital, Charleston, S.C.

University of South Carolina Athletic Dept.
Columbia, S.C.

Finger Clinic, Marion, S.C.

Brint Hospital, Bolivar, Tennessee

Airway Clinic, Memphis, Tennessee

Gartley-Ramsey Hospital, Memphis, Tenn.

Sayers, Duncan, Stephens Clinic,
Nashville, Tennessee

University of the South Athletic Dept.
Sewanee, Tenn.

Ghormley Hospital Clinic
Corpus Christi, Texas

Falfurrias Clinic, Falfurrias, Texas

Bohman Clinic, Cuero, Texas

Missouri Pacific Employees Clinic
Kingsville, Texas

Medical and Surgical Clinic, Laredo, Texas

Torbett Hospital and Clinic, Marlin, Texas

April 2, 1954

A DISCUSSION
of the
PRESENT STATUS OF ULTRASONICS

Further evidence of the potency of Ultrasonic therapy accumulates almost daily. It is becoming more and more apparent that this is a modality here to stay. Unfortunately, there has been so much aimless talk already about this energy that more confusion than understanding and more doubt than conviction has been created.

From the imposing lists of diseases benefited by Ultrasonics, ranging from warts and boils to tuberculosis and stomach ulcers which some manufacturers are circulating to exploit their product, it would almost seem that Ultrasonic energy is not a mere modality but rather a complete system of therapy in itself.

Doctors spend many years and much money to qualify for their degrees. Then, more years are spent in practice proving those measures which are dependable. Would it not appear that these years and that money were expended to little avail if with any simple device everything from dandruff to bunions could be cured, as if by magic, as some present exploitation of Ultrasonics would seem to imply.

There are, however, three or four conditions in which Ultrasonics has demonstrated its effectiveness as the method of choice over many older conventional modalities. There is ample proof to support the statement that Ultrasonics is superior to some of the older methods of approach in at least these conditions.

One of the things that Ultrasonics does is RELIEVE PAIN in a number of the hard-to-treat conditions which the physician sees regularly. Among these are sub-deltoid "bursitis", the "rheumatics", "neuritis" and so-called low-grade back distress. In some instances the relief is dramatic.

Is that just another advertising statement? It is not, nor is it gleaned from the writings of European fanatics unknown to the medical profession. It is a proven fact based upon the published reports of some of the most reputable workers in the American field of therapeutics.

John H. Aldes, M.D., F.A.C.S., Department of Physical Medicine and Rehabilitation, Cedars of Lebanon Hospital, Los Angeles, and an orthopedic surgeon in speaking of sub-deltoid "bursitis", both chronic and acute, states:

> "I want to tell you that I have performed only two operations by the Abbott technic in the past two and one-half years, and those only because I wanted to find out what type of calcareous deposit was in the bursa. As far as I am concerned, the method of choice at the present time will be Ultrasound, until I have proved otherwise after continuation of X-Ray studies and evaluation of these patients". (American Journal of Physical Medicine, February, 1954)

Dr. Aldes' statement is not based on supposition. It is a simple statement of fact based on experience with 187 cases.

H. J. Behrend, M.D. and Jerome Weiss, M.D., New York City, make a significant statement concerning the diseases predominant in old age among which they enumerate the so-called "rheumatic" diseases, neurologic disorders, trauma and traumatic complications of other diseases:

> "Ultrasonic therapy applied locally and to the segmental roots has given results which in many instances are superior to those obtainable by other means at our disposal. The criteria of improvement of our cases are relief of pain and paresthesia, increased range of joint motion and lessening of swelling, atrophy and contracture. . .We feel that our clinical experience based on 6,000 treatments given over a period of three and one-half years is consistent with the following conclusions. Ultrasonic therapy is a valuable form of treatment which is not dangerous within the therapeutic limits of accepted dosage in competent hands. Further investigation along the lines we have indicated will undoubtedly establish firmly the value of Ultrasonic therapy in geriatrics". (American Journal of Physical Medicine, February, 1954)

The statement of Drs. Behrend and Weiss is not based on supposition. It is a simple statement of fact based on experience involving some 6,000 treatments.

Arthur C. Jones, M.D., Portland, Oregon, in discussing the broad category of diseases termed "neuritis", says:

> "Neuritis is a term which has almost ceased to have a specific meaning. Probably, a majority of cases which used to be classed as brachial or sciatic neuritis were actually radiculitis. . . The observed fact is that patients do experience analgesia with relatively tiny doses of Ultrasound energy over irritated nerves, or their roots, when properly directed. Patients with sciatic neuritis following compression, respiratory infections or reaction from antibiotics or drugs have reported rapid and permanent relief of pain when Ultrasound was added to the usual mild radiant heat, analgesic medication and vitamin B therapy". (American Journal of Physical Medicine, February, 1954)

Dr. Jones' statement is not based on supposition. It is a simple statement of fact based on some two years clinical work.

Such reports could go on almost indefinitely because the literature merely emphasizes similar experiences of others. Probably, the best summation of the present status of Ultrasonics is found in the conclusions of Aldes and his co-workers:

> "In our opinion Ultrasound is not a substitute but rather an addition to the other modalities employed. A combination of Ultrasonic radiation with other conservative measures has proved especially effective when patients failed to benefit from conventional treatment or Ultrasonic therapy alone".

So, here are three of the hard-to-treat conditions with which every Physician has to contend and in which pain is the predominant characteristic. To those who have suffered the excruciating agony of acute bursitis, sciatic or brachial "neuritis" and the like or the exhausting persistence of chronic bursitis

and the "rheumatics", such involvements are the epitome of pain. So, they call upon their doctors for relief as rapidly as possible.

Pertaining to these very conditions review the import of some of the statements in the previous reports:

> "Results which in many instances are superior to those obtainable by other means at our disposal" . . . "Relief of pain and paresthesia, increased range of joint motion and lessening of swelling" . . . "Rapid and permanent relief of pain" . . . "Especially effective when patients failed to benefit from conventional treatment" . . . "The method of choice at the present time will be Ultrasound" . . .

Warts can be fulgurated. Boils can be lanced. It is a matter of record that some very effective drugs are combating tuberculosis. Stomach ulcers are controlled by dietetic and medicinal measures. So why prattle about Ultrasonics for conditions in which conventional methods have proven their dependability? Why not, instead, strongly urge its use in those several indications where, as set forth in the above references, it is known to be highly efficacious?

Another important factor in the consideration of Ultrasonics is conservation of time. An effective treatment with Diathermy demands a minimum of 20 minutes and 30 minutes is better. In fact, few if any Physical Medicine modalities can be administered effectively in less than ten to thirty minutes. With Ultrasonics all authorities on the subject agree that <u>three</u> to <u>six</u> minutes is ample for treatment of any single area.

In substance then, here is a new method of treatment which has proven itself in the hands of qualified authorities as being particularly effective for these difficult cases. The dramatically spectacular results obtained in some of the less complicated conditions are merely an added bonus.

This is the status of Ultrasonics today!

H. G. FISCHER & CO.

H. G. FISCHER & Co. ULTRASONIC GENERATOR

Manufactured solely in Franklin Park, Illinois

1 Federal Communications Commission Type Approval No. U-106
2 Underwriters' Laboratories Approval
3 Beautiful Chrome Plated Cabinet
4 Each Generator Individually Calibrated for Accuracy
5 Extra Large Active Crystal Surface of 10 Square Centimeters
6 Output up to 3 Watts per Square Centimeter — 30 Watts Total
7 Energy Intensity Distributed Over Entire Treatment Face of Transducer — A Mandatory Feature for Accurate Dosage
8 Easy-to-Read Meter Accurately Shows Amount of Ultrasound Patient is Receiving
9 Accurate Treatment Timer
10 Guaranteed for One Year Against Defects in Material and Workmanship

Operates from the Usual Office Wall Outlet of 120 Volts, 50-60 Cycles

H. G. FISCHER & CO. ESTABLISHED 1910

9451-91 W. Belmont Ave., Franklin Park, Illinois

(CHICAGO SUBURB)

H. G. FISCHER & CO. Model No. 6
ULTRASONIC GENERATOR

Manufactured solely in Franklin Park, Illinois

Extremely Low Priced

The H. G. Fischer & Co. Model No. 6 Ultrasonic Generator is practically trouble free and simple to operate. It consists of a single-tube rectified and filtered power supply, a single-tube oscillating circuit and a shielded, flexible coaxial cable connecting the oscillating circuit to the Transducer.

The Model No. 6 is manufactured in Franklin Park, Ill., (a Chicago Suburb) by highly skilled craftsmen, of the finest materials, and precision engineered for efficient performance and great durability.

ELECTRONIC GENERATOR

The Electronic Generator in the H. G. Fischer & Co. Model No. 6 Ultrasonic Generator is a high-frequency oscillator of the highest quality. The electronic impulses it generates and impresses upon the quartz crystals are tuned to match precisely the mechanical vibration frequency of the quartz crystal. The entire unit is completely shielded and is equipped with a specially constructed line filter that reduces feed-back of high frequency on the supply line to the very minimum. H. G. Fischer & Co. Model No. 6 Ultrasonic Generator has the Federal Communications Commission Type Approval No. U-106 and the Underwriters' Laboratories Approval.

Each Electronic Generator is individually calibrated with a Siemens Sonatest—a high-precision calibration device that is the accepted method of calibration by the Food and Drug Administration.

TRANSDUCER

The H. G. Fischer & Co. Ultrasonic Transducer is composed of a quartz crystal cemented securely in the head, and an electronic contactor held firmly against the crystal by a strong spring tension. The crystal has an area of 10 square centimeters. A rubber grip prevents the transmission of vibrations into the operator's hand. The entire Transducer weighs but 12 ounces; and the flexible coaxial cable from the Electronic Generator to the Transducer weighs only 4 ounces.

The quartz crystal used in the H. G. Fischer & Co. Ultrasonic Unit is cut from the mother crystal along predetermined lines of activity and is precisely ground by specialists to a specified dimension which determines the frequency at which it will vibrate—one million cycles per second. The **frequency** of the oscillations remains constant throughout the power range of the unit. The **intensity** of the vibrations can be varied, however, by applying more or less electronic power to the crystal.

Fabrication of the Transducer is as precise and critical as that required in the preparation of the quartz crystal. The end plate, to which the quartz crystal is cemented, is made to possess exactly the same properties of oscillation as the quartz crystal to prevent it from absorbing the mechanical motion and reducing the total output. Furthermore, the Transducer is hermetically sealed to prevent the seepage of water when used in any of the under-water technics.

The flexible coaxial cable connecting the Electronic Generator to the Transducer is shielded with Polyethylene, a vastly superior insulation specified by the Armed Forces for insulation on all battlefield communication wire and cable. The cable is of ample length for use of the Transducer with a patient on a treatment table.

OUTPUT METER

The meter shows both the output in watts per square centimeter and the total output in watts—From 1/10 watt to 3 watts per square centimeter or 1 watt to 30 watts total output. By observing the meter it is easy to determine if the Transducer is in proper contact with tissue for effective treatment and also how much ultrasound output the patient is receiving. It is not necessary to depend upon unreliable lights or other gadgets.

CONTROL

A single, stepless control regulates the ultrasound output of the unit from 0 on the left to 3 watts per square centimeter (30 watts total) on the right. This is considerably higher than most other ultrasonic units, as shown by actual comparative tests.

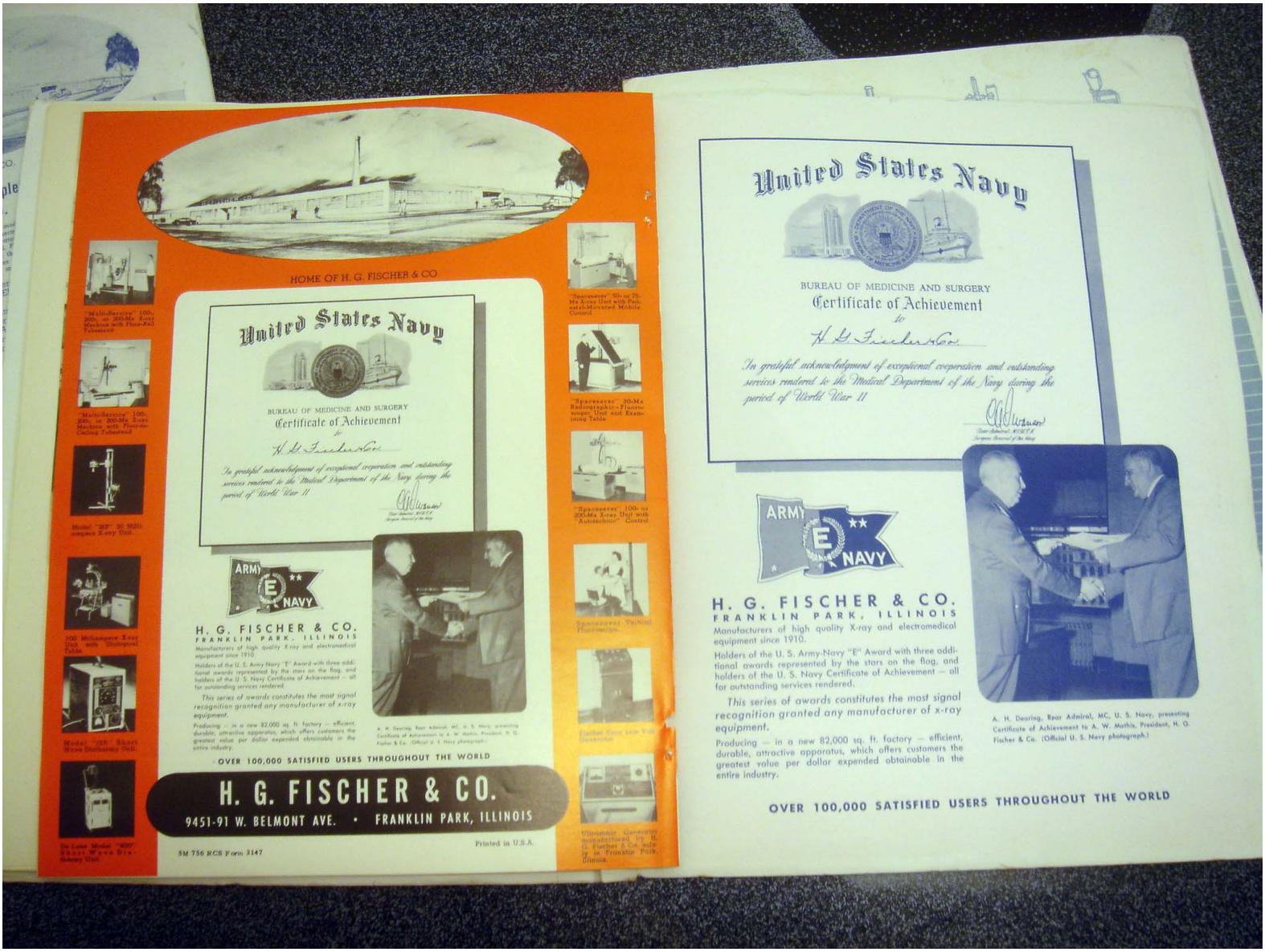
TREATMENT TIMER

The H. G. Fischer & Co. Model No. 6 Ultrasonic Unit is equipped with a combination power switch and treatment timer which turns off the current at the end of any desired treatment time from one to fifteen minutes.

CHROME-PLATED CABINET

The H. G. Fischer & Co. Model No. 6 Ultrasonic Unit is housed in a beautiful chrome-plated cabinet 16½" long, 10" deep, and 12¼" high. The complete unit weighs only thirty-eight pounds. A mobile utility stand is available.

Cat. No.	Code	Description
4657A	AKUAL	H.G. Fischer & Co. Model No. 6 Ultrasonic Generator
5023	TUBUL	Tubular Mobile Utility Stand



HOME OF H. G. FISCHER & CO

United States Navy

BUREAU OF MEDICINE AND SURGERY

Certificate of Achievement

to

H. G. Fischer & Co.

In grateful acknowledgment of exceptional cooperation and outstanding services rendered to the Medical Department of the Navy during the period of World War II

ARMY E NAVY

H. G. FISCHER & CO.

FRANKLIN PARK, ILLINOIS

Manufacturers of high quality X-ray and electromedical equipment since 1910.

Holders of the U. S. Army-Navy "E" Award with three additional awards represented by the stars on the flag, and holders of the U. S. Navy Certificate of Achievement — all for outstanding services rendered.

This series of awards constitutes the most signal recognition granted any manufacturer of x-ray equipment.

Producing — in a new 82,000 sq. ft. factory — efficient, durable, attractive apparatus, which offers customers the greatest value per dollar expended obtainable in the entire industry.

A. H. Dearing, Rear Admiral, MC, U. S. Navy, presenting Certificate of Achievement to A. W. Mathis, President, H. G. Fischer & Co. (Official U. S. Navy photograph.)

OVER 100,000 SATISFIED USERS THROUGHOUT THE WORLD

H. G. FISCHER & CO.

9451-91 W. BELMONT AVE. • FRANKLIN PARK, ILLINOIS

SM 756 RCS Form 3147

Printed in U.S.A.

HOME OF H. G. FISCHER & CO.

Representative Units of the Complete Line of H. G. FISCHER & CO.

The complete H. G. FISCHER & CO. line includes many models of Modern X-ray apparatus (medical and dental), Short Wave Diathermy Units, Ultrasonic Units, Low Volt Generators, Thermo-Flo, Infra Red Generators, other apparatus, supplies and accessories. H. G. FISCHER & CO. has always maintained the policy of meeting or exceeding the standards of any competing units designed for the same purpose, regardless of price, and pricing all apparatus at the lowest point consistent with quality manufacture.

SINCE 1910, H. G. FISCHER & CO. has been one of the largest manufacturers of Shockproof X-ray and Electromedical equipment. Pioneers in the field of X-ray and Electromedical equipment, H. G. FISCHER & CO. is recognized throughout the world today for apparatus of dependable service and great durability. H. G. FISCHER & CO. is the ORIGINAL COMPANY. It has no connection with any other company having a similar name. No H. G. FISCHER & CO. equipment is manufactured outside of the Chicago area.

More than forty-four years of experience in engineering, design and construction of X-ray and Electromedical apparatus, together with fine workmanship and materials, are built into all H. G. FISCHER & CO. apparatus. The fact that today over 100,000 physicians, dentists, hospitals, clinics, universities and other medical organizations in the United States and throughout the world use H. G. FISCHER & CO. apparatus reflects its outstanding quality and service.

All H. G. FISCHER & CO. apparatus is serviced and sold through factory-trained representatives who are well qualified to render necessary technical assistance. Our comparatively small overhead expense and factory-trained representation enable us to give purchasers such value per dollar expended as cannot be excelled by any other manufacturer in the field.

The home of H. G. FISCHER & CO. is now conveniently located at 9451-91 W. Belmont Ave., Franklin Park, Illinois, a western suburb of Chicago (3200 North and 9400 West, by the Chicago numbering system). Doctors are cordially invited to visit the H. G. FISCHER & CO. plant, where modern X-ray and Electromedical equipment will be displayed and demonstrated. A visit entails no obligation.

De Luxe RF 250 Milliampere X-ray Apparatus with Hand-Tilted or Motor-Driven Table.

"Multi-Service" 300 or 100 Milliampere X-ray Apparatus, Hand-Rocked or Motor-Driven Table.

MP 30 Milliampere Mobile-Portable Shockproof X-ray Apparatus.

100 Milliampere X-ray Unit with Urological Table.

Model "10A" Short Wave Diathermy Unit.

De Luxe Model "400" Short Wave Diathermy Unit.

Multi-Purpose 100 Milliampere X-ray Apparatus With Multi-Purpose Tilt Table.

Spacesaver Radiographic-Fluoroscopic Unit and Examining Table, 30, 50, 75 Milliamperes.

Spacesaver Radiographic-Fluoroscopic Unit and Examining Table, 100, 200 Milliamperes.

Spacesaver Vertical Fluoroscope.

Ultrasonic Generator manufactured by H. G. Fischer & Co. solely in Franklin Park, Illinois.

TC 30, 50, or 75 Milliampere Shockproof X-ray Apparatus.

H. G. FISCHER & CO.

9451-91 W. BELMONT AVE. • FRANKLIN PARK, ILLINOIS

10M S 156 Form 3125A

Printed in U.S.A.